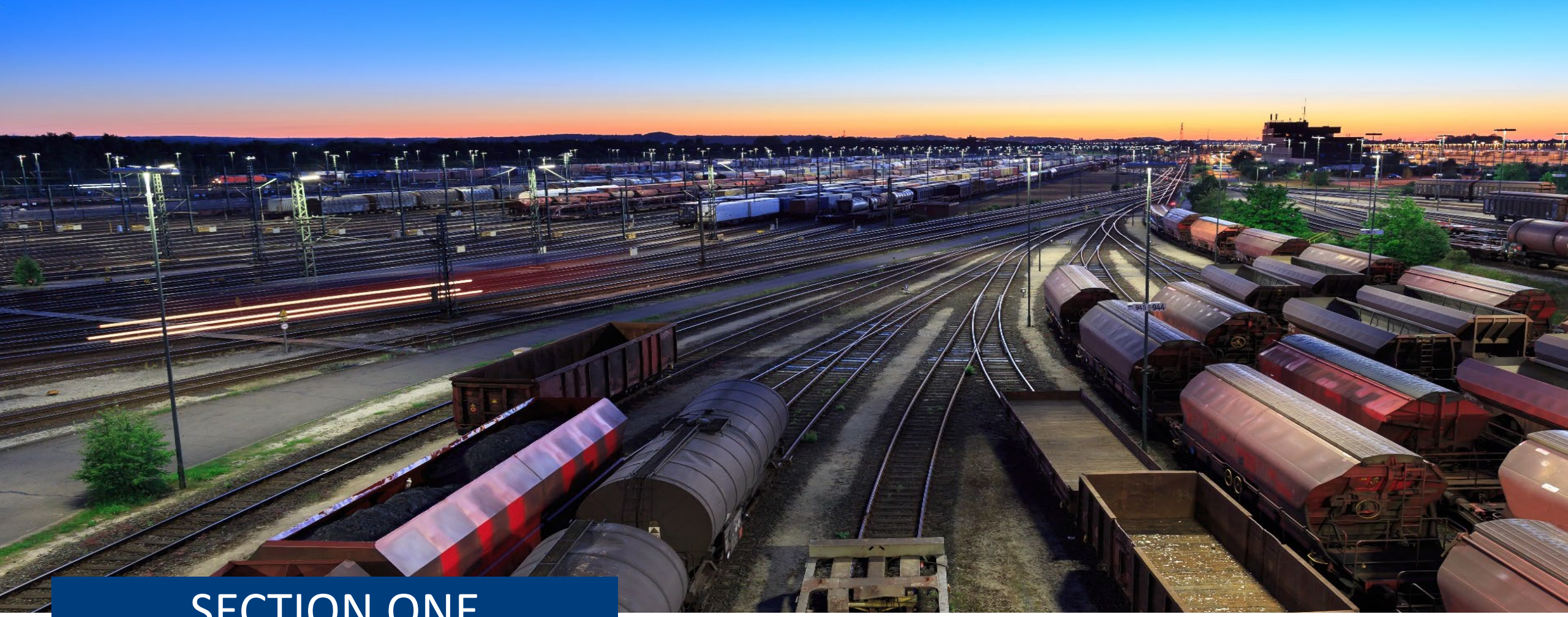
RAIL

MOVING AMERICA FORWARD

FRA Office of Research, Development, and Technology

Current Research Projects



SECTION ONE

TRACK

Development, Improvements, and Support of the GPR system on DOTX 220 (Phase I)

PROJECT DESCRIPTION

- Provide ongoing technical support and further improvement of the autonomous GPR system deployed on DOTX 220, including control software upgrades, improvements to data pre-processing, and modifications to the real-time report PDF template.
- Integration of GPR and MRAIL for enhanced assessment of trackbed defects. Yrel exceptions generated by the MRAIL system on DOTX 218 will be included as triggers into the GPR real-time reporting system and incorporated on the PDF reports.
- To improve data availability, implement an automated upload of GPR data from DOTX 220 to a cloud repository.
- Redesign the RASC Manager portal to improve the visibility and accessibility of the processed GPR data to FRA inspectors.
- Provide detailed Trackbed Inspection Reports for requested locations of interest.

RAILROAD IMPACT

- Broaden the application of GPR to characterise trackbed condition associated with track geometry defects and low trackbed stiffness, contributing to quicker root cause assessment.
- Automatically monitor problem areas to assist with tracking trackbed condition change.
- Provide practical uses of technology to improve railroad safety and inspection and maintenance practices.

PROJECT PARTNERS

- Rhomberg Sersa USA Inc.
- Zetica Rail

COST & SCHEDULE

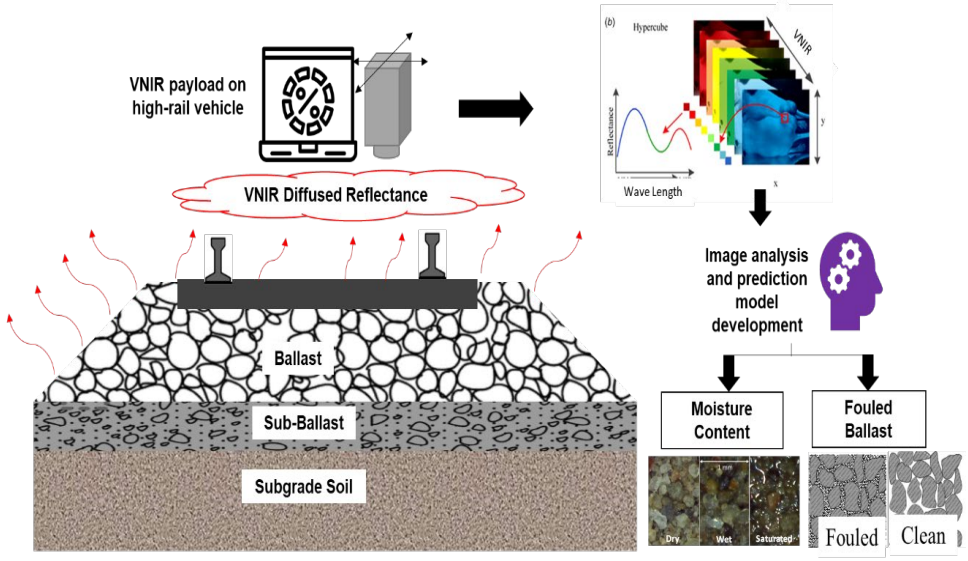
- Funding: $469,192
- Project Duration: September 2025 – September 2026

FRA PROJECT MANAGER: Hugh B. Thompson II • (202) 493-6383 • hugh.thompson@dot.gov

Railroad Substructure Moisture Measurement and Monitoring Using Hyperspectral Imagery

PROJECT DESCRIPTION

- Noncontact evaluation of railroad ballast:
  - To detect and measure moisture content.
  - To detect and measure fouling contamination.
  - To detect and measure both **simultaneously.**
- Hypothesis: The presence of water and contamination in a granular medium such as ballast changes its *light reflectance.*
- Hyperspectral sensors are used to prove the concept and to measure light reflectance under relevant environment.
- Technical and monthly financial reports will be submitted to FRA.
- Spectral signature of fouled ballast (collected after a real derailment) was distinguished.
- A payload will be tested for realistic data collection and for real-time data analysis.



RAILROAD IMPACT

- Immediate safety improvements:
  - Noncontact sensing is safer for inspectors.
  - Light reflectance of derailed ballast exhibit distinct spectral features associated with excessive fouling.
- Increased efficiency and sustainability:
  - Reduce the required resources.
  - Potentially prolong ballast life.

PROJECT PARTNERS

- University of North Dakota
- Red River and Western Railroad Company
- North Dakota State University

COST & SCHEDULE

- Funding: $416,791
- Project Duration: September 2022 – September 2026

FRA PROJECT MANAGER: Hugh B. Thompson II • (202) 493-6383 • hugh.thompson@dot.gov

Support for Testing with FRA Inspection Fleet II

PROJECT DESCRIPTION

- FRA owns several inspection vehicles used for rail safety assurance and improvement under the Automated Track Inspection Program. The Office of Research, Development, and Technology (RD&T) has several systems installed on the inspection fleet vehicles used for R&D efforts.
- This task focuses on supporting the operations, maintenance, repairs and upgrades to the RD&T systems installed on the DOTX 218/DOTX 220 consist, including the Vertical Rail Deflection Measurement System (VRDMS) and GPR.
- Provide engineering support for FRA RD&T test efforts and new technologies with the FRA inspection fleet.

RAILROAD IMPACT

- Provide research platforms to develop, improve, and demonstrate track inspection technologies.
- Allow for the expansion of current track inspection capabilities throughout the railroad industry.
- Improve railroad safety and maintenance practices.

PROJECT PARTNER

- ENSCO, Inc.

COST & SCHEDULE

- Funding: $299,999
- Project Duration: July 2025 – July 2026

FRA PROJECT MANAGER: Hugh B. Thompson II • (202) 493-6383 • hugh.thompson@dot.gov

Intelligent Track Transitions Using Optical Fiber Sensors

PROJECT DESCRIPTION

- Develop a continuous and automated optical-fiber-sensor–based monitoring system to measure strain, deflection, load distribution, and support conditions at critical railroad track transitions.
- Evaluate and compare multiple optical fiber sensor technologies (FBG, LPG, IF-P) through laboratory testing to determine durability, sensitivity, and suitability for long-term railroad deployment.
- Integrate advanced machine-learning algorithms to detect anomalies, classify track condition, and provide actionable, data-driven maintenance insights.
- Field-validate the monitoring system at the Transportation Technology Center (Pueblo, CO).
- Develop a Compound Track Performance Index Parameter (C-TPIP) combining key structural responses to deliver a single, practical metric for railroad agencies to assess track health and prioritize maintenance.

RAILROAD IMPACT

- Reduced maintenance costs.
- Improved safety and reliability through continuous, real-time monitoring of critical track transition behavior.
- Minimized service disruptions.
- Enhances asset management decisions with a quantified health index (C-TPIP) for track segments.

PROJECT PARTNERS

- Oklahoma State University
- Virginia Tech

COST & SCHEDULE

- Funding: $614,289
- Project Duration: 42 months

FRA PROJECT MANAGER: Hugh B. Thompson II • (202) 493-6383 • hugh.thompson@dot.gov

Detection of Large-scale Soil Moisture Content, Pore Water Pressure, and Matric Suction Using Electrical Resistivity Imaging Technique

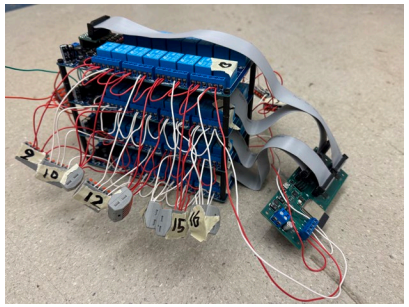
PROJECT DESCRIPTION

- Design and develop an IoT-based, 2D, temporal electrical resistivity system for continuous, real-time monitoring of soil moisture content and ballast condition for track performance and safety.
- Deploy network of IoT resistivity sensors and commercial sensors on a test track facility subject to rainfall simulation to collect continuous resistivity, moisture, temperature, and pore pressure data.
- Improve existing predictive models to detect subsurface moisture and geotechnical anomalies with the test track facility data to detect ballast fouling and identifying ballast pockets and track subsurface anomalies.

RAILROAD IMPACT

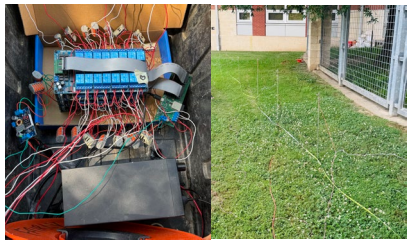
- Provide a continuous and efficient large-scale moisture monitoring system for railway infrastructure, leading to enhanced maintenance practices and increased safety measures.
- Detect foul percentages in railway tracks by analyzing variations in electrical resistivity corresponding to changes in moisture content.
- Reduce maintenance costs by detecting potential failure zones early, preventing costly repairs and ensuring track integrity.

16 Electrode 2D ERI System (TRS)

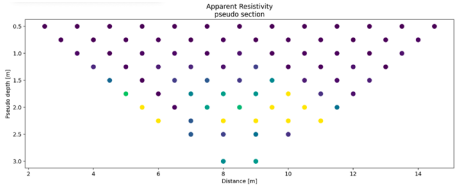


16 Electrode ERI System set up in ERDC Test track

Deployment of TRS sensor In Lab Setup



2D result from the ERI Device



PROJECT PARTNERS

- U.S. Army Engineer Research and Development Center
- Jackson State University

COST & SCHEDULE

- FY25–26 Funding: $186,527
- Project Duration: September 2023 – August 2026

FRA PROJECT MANAGER: Hugh B. Thompson II • (202) 493-6383 • hugh.thompson@dot.gov

Innovative Track Inspection Technologies III

PROJECT DESCRIPTION

- Support the introduction of new track inspection approaches and the advancement of existing track inspection technologies, with a focus on data interpretation and analysis.
- Develop alternative approaches to directly measure absolute vertical defection under load.
- Provide engineering and data analysis support for the gage restraint measurement system, ground-penetrating radar, the vertical track deflection measurement system, and similar track evaluation technologies.
- Investigate alternative methods to assess the tie support conditions using fiber optics, fiber Bragg gratings sensors, or other means that can indicate non-uniform support conditions over longer segments of the track.
- Support field activities for FRA track research.

RAILROAD IMPACT

- Broaden the application of innovative technologies to detect degraded track conditions.
- Improve the understanding of track behavior by characterizing various track components and parameters.
- Provide practical uses of technology to improve railroad safety and maintenance practices.

PROJECT PARTNER

- ENSCO, Inc.

COST & SCHEDULE

- FY26 Funding: $299,922
- Project Duration: September 2025 – September 2027

FRA PROJECT MANAGER: Hugh B. Thompson II • (202) 493-6383 • hugh.thompson@dot.gov

Crushed Aggregate Gradation Evaluation System

PROJECT DESCRIPTION

- Develop a portable, rapid, and easy-to-use ballast inspection technology.
- Originally devised as a fouling index from surface images taken with a smartphone, and developed into subsurface imaging system.
- Uses deep-learning computer vision to analyze particle sizing, discriminate large particles, fines, and voids, and gives an equivalent fouling index in real time.

RAILROAD IMPACT

- System for railroads and FRA inspectors to easily and quickly characterize subsurface ballast condition in the field in real time.
- GPR ground-truthing.
- Improved railroad safety through inspection and maintenance operations.
- Broadens the application of innovative technologies to detect degraded track conditions.

PROJECT PARTNER

- Oceanit Laboratories, Inc.

COST & SCHEDULE

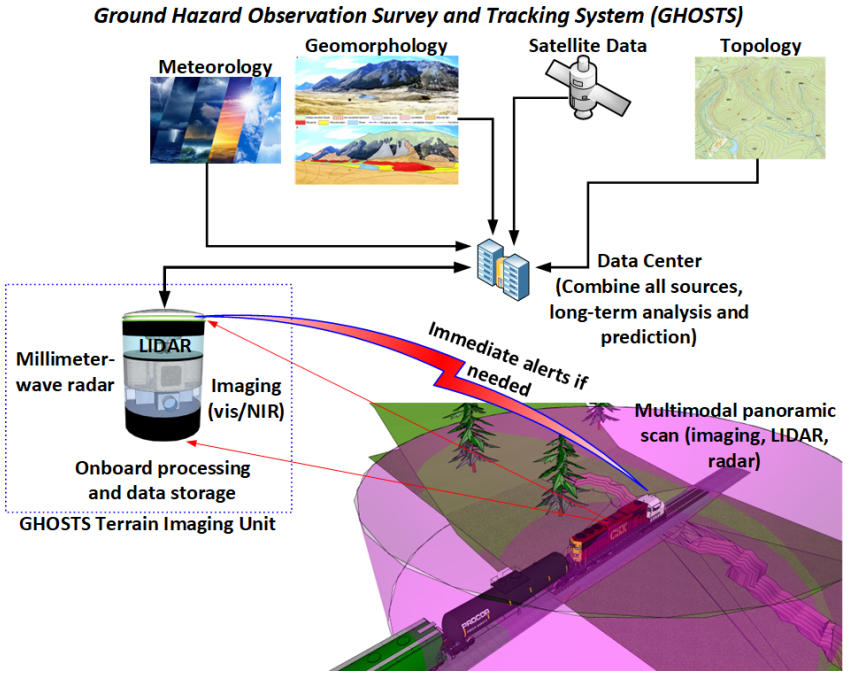
- Funding: $299,974
- Project Duration: September 2024 – August 2026

FRA PROJECT MANAGER: Hugh B. Thompson II • (202) 493-6383 • hugh.thompson@dot.gov

Ground Hazard Observation Survey and Tracking System (GHOSTS)

PROJECT DESCRIPTION

- Create a self-contained, multisensory mobile mapping unit to consistently survey terrain surrounding railroad lines.
- Multisensor data aggregation and fusion (e.g., LiDAR, millimeter-wave radar, visible and near-IR light, thermal, GPR) provide robust and information-dense models of existing terrain.
- Integrating with external data sources (e.g., USGS topology and geomorphology, weather history and predictions, satellite and drone imagery, etc.) allows detection, identification, measurement, and evaluation of potential issues (e.g., slope creep, sagging retaining mesh, erosion near tracks) to allow remediation before actual emergency events.
- Real-time evaluation/detection of more immediate threats (e.g., moving boulders, obstacles on track).
- Trackbed evaluation with added local sensing module.
- Integrate with infrastructure planning/maintenance systems.



RAILROAD IMPACT

- Reduce derailments/accidents caused by washouts/landslides and similar events.
- Increase safety and reliability.
- Reduce costs through preventative measures rather than after-the-fact remediation.
- Improve awareness of track and environmental conditions of relevance to train operations.

PROJECT PARTNER

- International Electronic Machines Corp.

COST & SCHEDULE

- Funding: $200,000 (Phase I SBIR)
- Project Duration: August 2025 – February 2026

FRA PROJECT MANAGER: Hugh B. Thompson II • (202) 493-6383 • hugh.thompson@dot.gov

Track Systems Safety Research — FRA/Volpe Interagency Agreement

PROJECT DESCRIPTION

Advance track safety and performance through:

- **Assessing derailment risk** by modeling and testing vehicle-track interaction, track component performance, and track system response.
- **Addressing key track failure mechanisms,** including broken rail, track buckling, gage widening, ballast/substructure degradation, and special trackwork deterioration.
- **Conducting derailment accident investigations** to identify root causes, contributing factors, and safety improvements.
- **Developing and validating inspection innovations and technologies** to enhance safety and efficiency.
- **Translating research findings to practice,** including supporting the FRA Office of Railroad Safety, and informing improved FRA track safety standards, industry standards, and maintenance practices to reduce track-related accidents.

RAILROAD IMPACT

- Reduced derailment risk via science-based inspection and maintenance strategies.
- Increased regulatory efficiency while improving safety.
- Novel engineering solution to extend track service life.
- Infrastructure resilience by ensuring reliability, enabling efficiency, supporting economic development, and considering future high-speed rail needs.

PROJECT PARTNERS

- Volpe National Transportation Systems Center
- Coordination and partnerships with industry (e.g., Amtrak, Class I railroads, suppliers), universities, TTC, and technology providers on joint research activities
- Collaboration with industry/academic partners in FRA-funded contracts and Broad Agency Announcement projects to ensure integrated, complementary results

COST & SCHEDULE

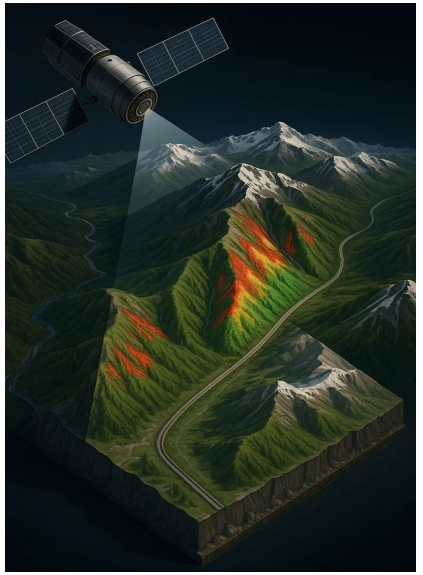
- FY25 Funding: $2.7M
- Project Duration: May 2025 – May 2030

FRA PROJECT MANAGER: Hugh B. Thompson II • (202) 493-6383 • hugh.thompson@dot.gov

Geohazard Susceptibility and Risk Forecasting Tool for Railroads
SBIR Phase I 25-FR3: Railroad Ground Hazard Mitigation Technology

PROJECT DESCRIPTION

- Develop and demonstrate new technologies to improve the efficiency and effectiveness of railroad ground hazard detection, monitoring, and warning systems.
- Proposed solution: A real-time geohazard risk forecasting tool that integrates historical, real-time, and forecasted data to enhance railroad geohazard detection, monitoring, and alert systems.
- Tool combines:
  - Publicly available terrain, geology, and EO satellite data sources
  - Weather and climate data
  - Railroad records



RAILROAD IMPACT

- Provide dynamic, real-time assessment of geohazard risks.
- Allow railroad operators to identify and remotely monitor high-risk locations and receive automated alerts when conditions indicate increased danger.
- Allow rail operators to make more informed decisions to spend limited funding to address portions of rail network most at-risk from geohazards.

PROJECT PARTNERS

- Emprise Concepts
- Bedrock Research
- Alaska Railroad Corp.

COST & SCHEDULE

- FY25–26 Funding: $206,468.21
- Project Duration: August 2025 – February 2026

FRA PROJECT MANAGER: Hugh B. Thompson II • (202) 493-6383 • hugh.thompson@dot.gov

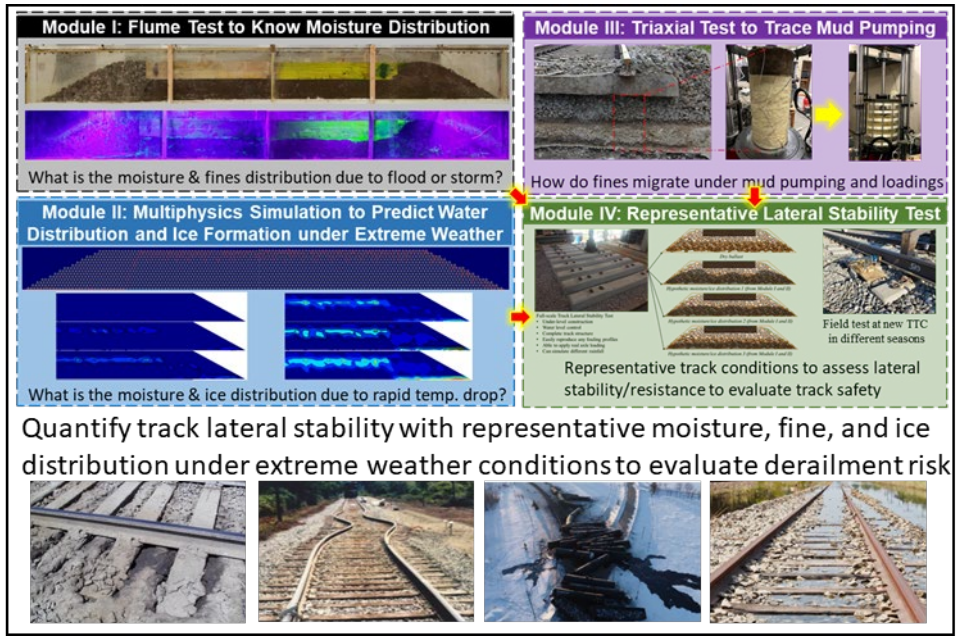
Track Lateral Stability Assessment under Extreme Weather Conditions

PROJECT DESCRIPTION

- Investigate reduced track lateral stability due to mud pumping, especially in rapid flooding events.
- Investigate reduced track lateral stability due to ice jacking, especially during polar vortexes.
- Explore the effects of freeze-thaw cycles on ballast support deterioration, especially during abrupt weather variations.
- Develop a numerical model of prediction to assist decision-making for field track inspection and maintenance.

RAILROAD IMPACT

- Insight on track lateral stability variation during and after extreme weather events.
- Provide guidelines for potential track disturbances ahead of natural disasters.
- Provide reference information to help to make cost-effective and proactive maintenance schedule.
- More accurate track safety and resilience assessments based on field-testing conditions.



PROJECT PARTNERS

- University of South Carolina
- BNSF, MxV Rail, RTS

COST & SCHEDULE

- Funding: $475,000
- Project Duration: September 2024 – September 2027

FRA PROJECT MANAGER: Hugh B. Thompson II • (202) 493-6383 • hugh.thompson@dot.gov

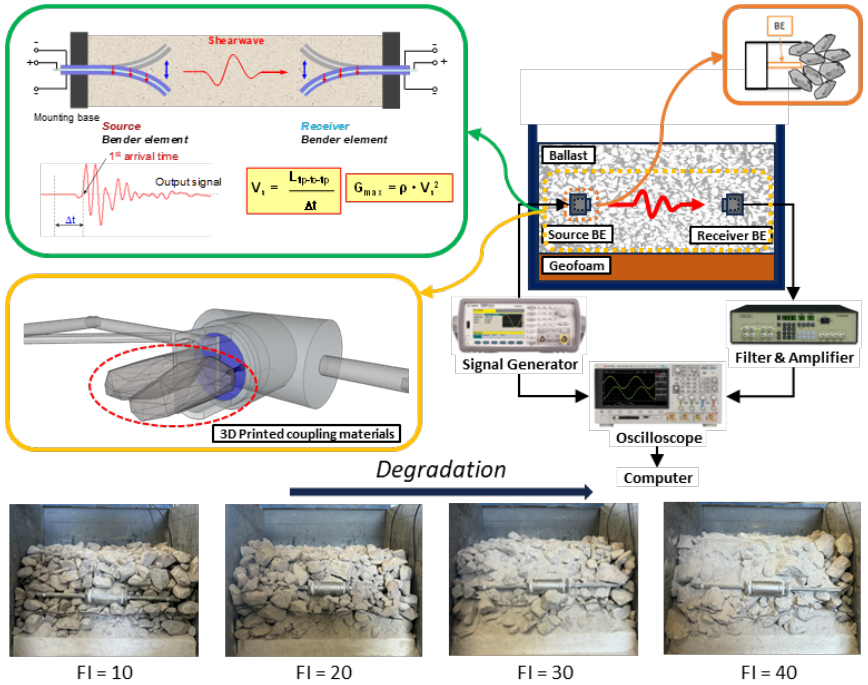
Bender Element Field Sensors for Long-Term Monitoring of Ballasted Track Condition

PROJECT DESCRIPTION

- Establish an advanced field-sensing technology using bender element (BE) sensors for quantifying stiffness characteristics and evaluating fouling condition of ballast and sub-ballast layers.
- Finalize design and manufacture field BE sensors for ballast stiffness determination.
- Install BE sensors both in laboratory and field railway facilities to conduct seismic testing and shear wave velocity measurements.
- Develop database with ballast fouling condition and shear wave measurements through the use field BE sensors.

RAILROAD IMPACT

- This research will develop a robust tool for field quantification of ballast stiffness characteristics based on embedded BE sensors and timely scheduling of maintenance activities.
- The long-term monitoring ability of embedded field BE sensors will allow practitioners to specify the ballast quality and stiffness during the design procedure.
- Successful research outcomes will provide the needed linkage between substructure conditions and track performance, thus ensuring safe operations and improving rail network reliability.



PROJECT PARTNERS

- BNSF
- Sol Solution
- ENSCO, Inc.

COST & SCHEDULE

- FY24–25 Funding: $220,000
- Project Duration: October 2024 – March 2026

FRA PROJECT MANAGER: Hugh B. Thompson II • (202) 493-6383 • hugh.thompson@dot.gov

VTI Testing, Modeling, and Analyses: Development of Model Parameters

PROJECT DESCRIPTION

- Develop a general procedure for gathering parameters for the vehicles and trucks to create validated simulation models.
- Perform tests and evaluation to measure parameters needed for modeling the selected railroad vehicles.
- Evaluate and model multiple vehicle and truck types.
- Use the Rail Dynamics Laboratory and various test tracks at the Transportation Technology Center to perform characterization tests and validate parameters for simulation models.

RAILROAD IMPACT

- Mitigate potential for derailment risk or other vehicle dynamic issues that compromise railroad safety.
- Improve the understanding and modeling of the dynamic interaction between a train and the railroad track.
- Provide validated parameters for models of different equipment or components used in railroad operations.
- Create simulations to assess vehicle responses to different situations, perform derailment investigations, and evaluate performance-based track geometry standards.

PROJECT PARTNER

- ENSCO, Inc.

COST & SCHEDULE

- FY23 Funding, Phase I: $691,889
- FY25 Funding, Phase II: $1,400,000
- Project Duration: July 2023 – November 2027

FRA PROJECT MANAGER: Alexandra D'Andrea • (202) 578-6218 • alexandra.dandrea@dot.gov

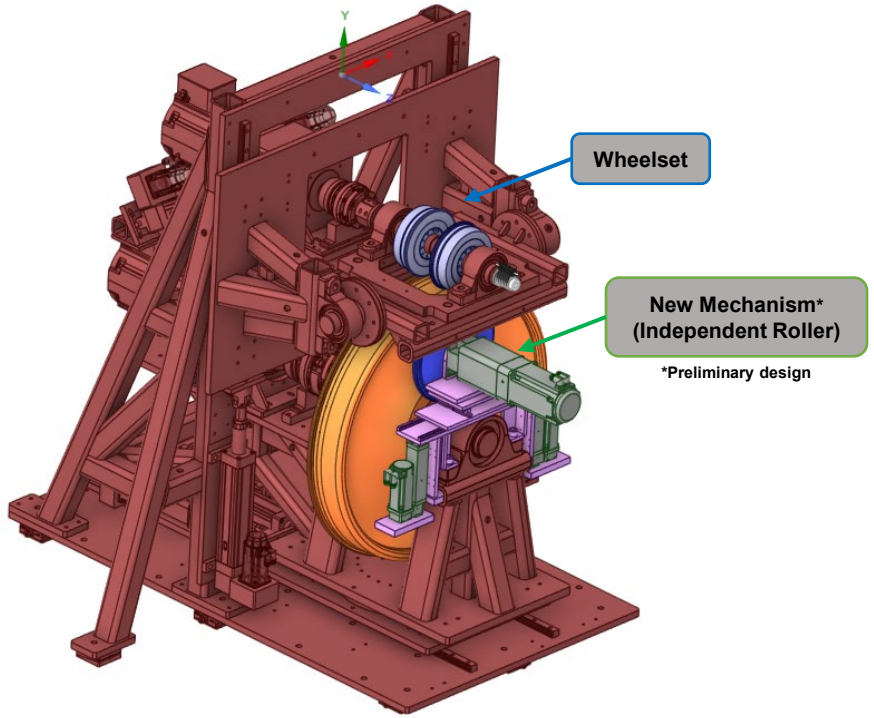
Redesign of the VT-FRA Roller Rig to Enable Single-Axle Testing

PROJECT DESCRIPTION

- Improve the existing VT-FRA Roller Rig by enabling wheelset (single-axle) testing.
- Design and fabricate a cutting-edge system that integrates a new, independent motorized roller into the VT-FRA roller rig.
- Enable independent, real-time measurements of contact forces and creepages at the wheels' contacts.
- Enable static and dynamic studies with various cant angles, angles of attack, and relative lateral displacements.
- Develop a high-precision control architecture.
- Conduct baseline validation studies in support of FRA's research, development, and safety mission.

RAILROAD IMPACT

- Provide a precise platform for railroad R&D to support innovation in wheel-rail interaction studies and future safety assessments.
- Conduct single-axle and dynamic curving studies toward improving the understanding of contact mechanics and improving U.S. railroads' operational efficiency.
- Enable accurate measurement and analysis of wheelset curving dynamics under varied test conditions.
- Generate validated, science-based data to support FRA in developing and refining safety standards and best practices.



PROJECT PARTNERS

- Virginia Tech
- Kollmorgen

COST & SCHEDULE

- Funding: $499,988
- Project Duration: September 2024 – September 2026

U.S. Department of Transportation
Federal Railroad Administration

FRA PROJECT MANAGER: Alexandra D'Andrea • (202) 578-6218 • alexandra.dandrea@dot.gov

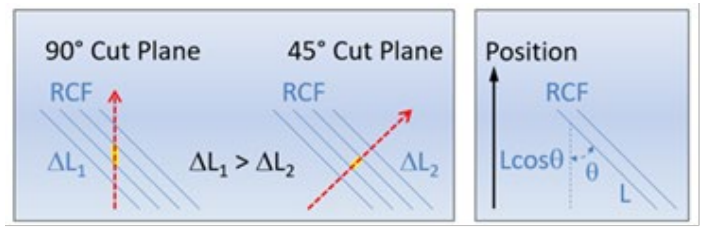
Wheel/Rail Interface Research and Investigation

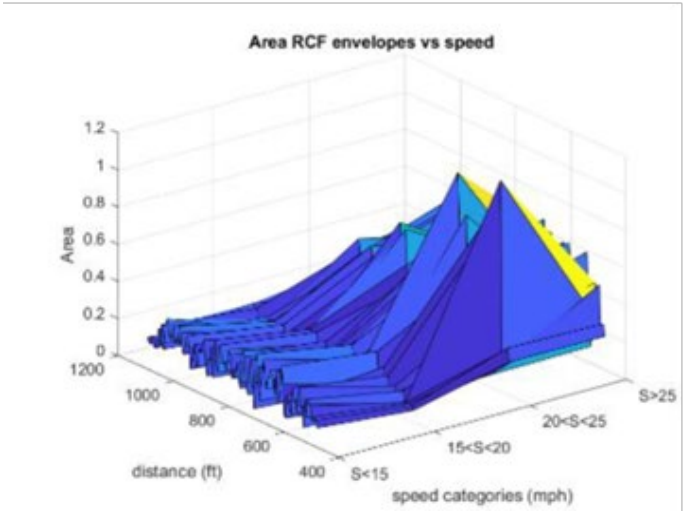
PROJECT DESCRIPTION

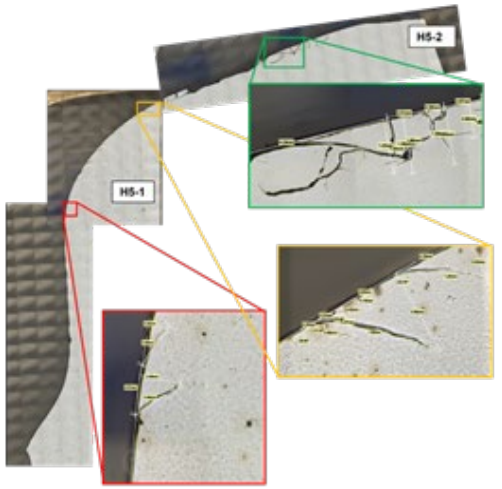
- Extend the previous research performed by NRC and the International Collaborative Research Initiative examining rolling contact fatigue (RCF) and rail wear.
- Conduct research in areas of vehicle-track interaction, RCF, and rail integrity.
- Improve upon an “RCF matrix,” quantifying rail running surface fatigue damage as a function of rail type and position in track, tonnage accumulation, traffic condition, and other environmental and maintenance conditions the rails are subjected to during their life cycle.
- Field testing and analysis on commuter railroad rail wear.

RAILROAD IMPACT

- Understanding relationships between visible surface damage and depth of damage, surface damage and risk (particularly with respect to ultrasonic testing and service failures), and developing and validating models of wear and surface fatigue.
- Understanding wear and RCF relationships that account for loading environment, curvature, type of steel, and friction conditions.
- Improved models, including well-characterized loading environment to well-characterized track to predict wear and RCF.
- Simulation results to provide a guidance to industry practitioners for improving rail safety.







PROJECT PARTNER

- NRC

COST & SCHEDULE

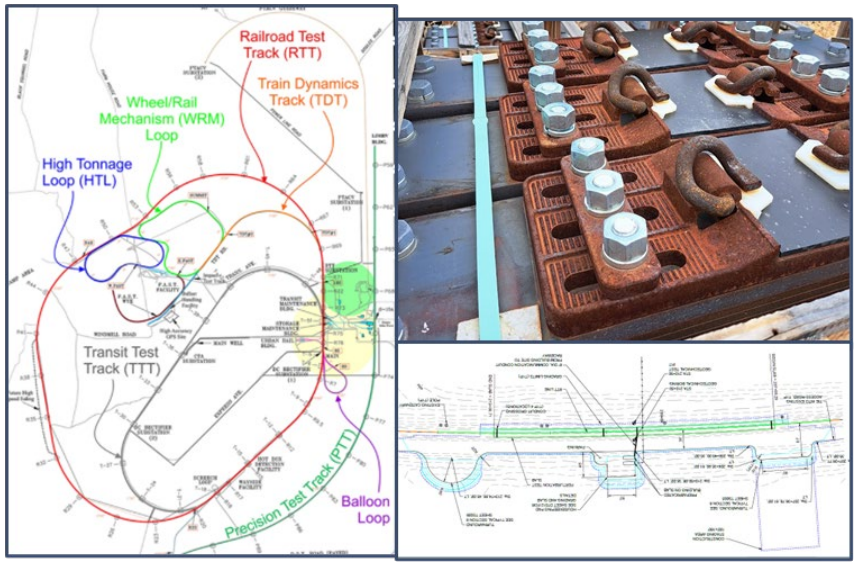
- FY24 Funding: $300,000 (Unfunded options: $450,000)
- Project Duration: September 2024 – September 2029

FRA PROJECT MANAGER: Alexandra D'Andrea • (202) 578-6218 • alexandra.dandrea@dot.gov

Curved Adjustable Precision Track Anomaly Test Section at TTC

PROJECT DESCRIPTION

- Review the preliminary design for the High-Speed Adjustable Precision Slab Track (HS-APS) on the curved segment of Railroad Test Track at the FRA Transportation Technology Center and produce drawings and specifications for construction.
- Construct the curve HS-APS according to the approved design.
- Provide technical supervision and quality assurance, and ensure compliance with the design specifications during construction.
- Preform commission testing to validate functionality of the curved portion of the new track.



RAILROAD IMPACT

- Enhance research capabilities by enabling controlled and repeatable geometric perturbations in curved track.
- Expand validation and calibration testing of onboard track geometry measurement systems in curves.
- Facilitate validation of rail vehicle models and qualification of new equipment and technology prior to its introduction into service.
- Improve track and vehicle safety through precise measurement and analysis of vehicle response to known adjustable perturbations.

PROJECT PARTNERS

- ENSCO, Inc.
- David Evans and Associates, Inc.
- Railworks

COST & SCHEDULE

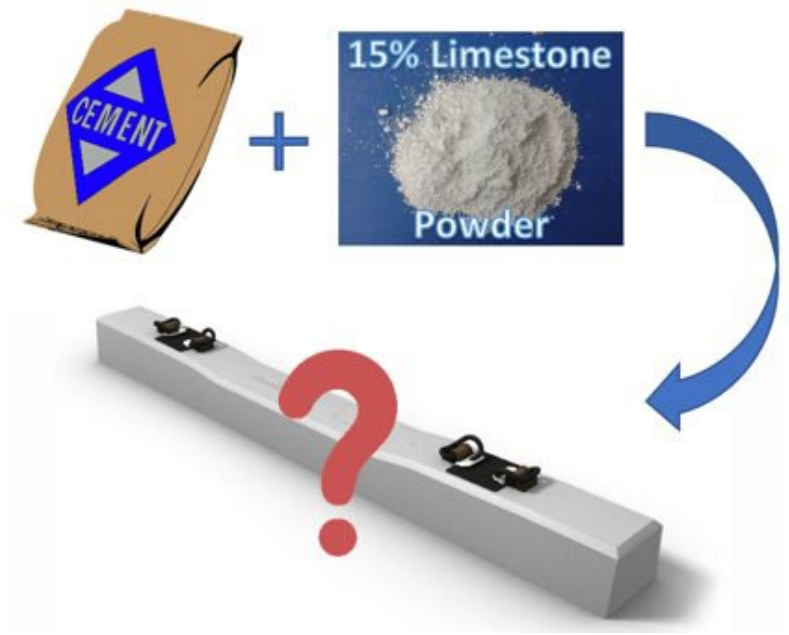
- FY25 Funding: $4,243,000
- Project Duration: February 2025 – August 2026

FRA PROJECT MANAGER: Alexandra D'Andrea • (202) 578-6218 • alexandra.dandrea@dot.gov

Type IL Cement in Prestressed Concrete Railroad Ties

PROJECT DESCRIPTION

- Conduct laboratory tests to evaluate bond changes that result when using Type IL cement.
- Evaluate the splitting potential of concrete ties manufactured with Type IL cement using the AREMA Splitting Resistance Test.
- Conduct load tests to failure to determine changes in tie moment capacity and failure modes.
- Measure transfer lengths of ties manufactured at the voestalpine Railway Systems Nortrak facility in Cheyenne, WY.
- Install instrumentation in Nortrak ties to determine long-term prestress losses with Type IL Cement.
- Evaluate potential changes in freeze-thaw durability and permeability of concrete mixes with Type IL cement.



RAILROAD IMPACT

- Identify problems that may arise when using Type IL cement in concrete railroad ties.
- Determine needed modifications in producing Type IL cement to ensure safe tie designs. Preliminary work indicates this will likely require higher concrete strengths prior to de-tensioning to ensure adequate bond.
- Present findings to AREMA Committee 30 and develop draft language for balloting and adoption in AREMA Chapter 30.

PROJECT PARTNERS

- RJ Peterman & Associates
- voestalpine Railway Systems Nortrak

COST & SCHEDULE

- FY23–24 Funding: $175,787
- Project Duration: August 2023 – September 2026

FRA PROJECT MANAGER: Alexandra D'Andrea • (202) 578-6218 • alexandra.dandrea@dot.gov

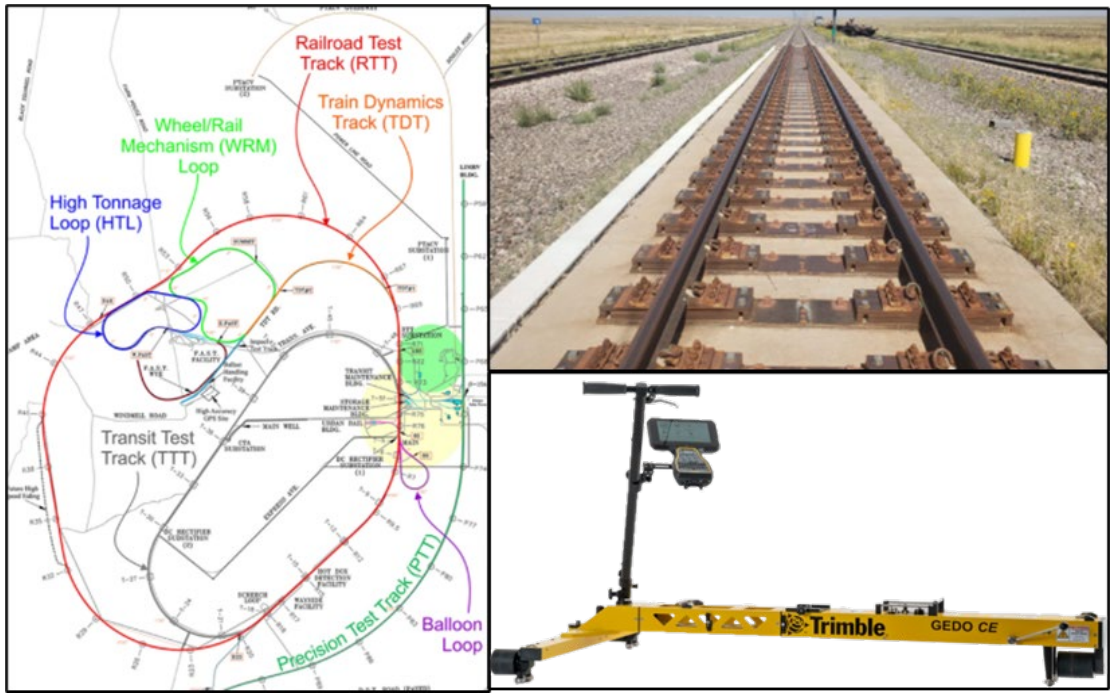
TTC Site Survey and Monument System

PROJECT DESCRIPTION

- Acquire commercial survey measurement system capable of providing an absolute coordinate reference for selected tracks at the FRA Transportation Technology Center (TTC).
- Install survey monument prisms for the system at selected track locations.
- Evaluate and ensure interoperability with exiting RTK system installed at TTC.
- Provide training for operation of the acquired system.
- Preform test runs of the acquired system to evaluate functionality.

RAILROAD IMPACT

- Provide accurate absolute geographic location references for track and track geometry measurements.
- Support detailed analyses of the track condition and alignment degradation over time.
- Provide accurate, comprehensive data on structural movements and deformations.
- Facilitate research and in-track testing requiring high-precision location references, including adjustable perturbation slab tracks.
- Enhance safety by reducing risks related to alignment or other positional errors.



PROJECT PARTNER

- ENSCO, Inc.

COST & SCHEDULE

- Funding: $750,000
- Project Duration: September 2025 – September 2026

FRA PROJECT MANAGER: Alexandra D'Andrea • (202) 578-6218 • alexandra.dandrea@dot.gov@dot.gov

Field Testing Support at the FRA Transportation Technology Center

PROJECT DESCRIPTION

- Provide multiple university- and third-party-led research initiatives with on-site testing services and equipment at the FRA Transportation Technology Center (TTC) to support technology evaluation in real-world settings.
- Previous phases of this project included:
  - Field validation of machine-vision algorithms designed to detect defective/missing fasteners.
  - Automated characterization of the severity of rolling contact fatigue on rail.
- Planned testing activities for this phase of the project include vehicle-based precision measurement of track geometry over the High-Speed/ Adjustable Perturbation Slab Track at TTC.

RAILROAD IMPACT

- Provide support for controlled testing at TTC, including opportunities for evaluation in real-world environments, for new and emerging technologies.
- Develop critical prototype hardware/software for advanced rail inspection technology.
- Focus on the development and evaluation of advanced inspection technologies under revenue-service-like conditions.

PROJECT PARTNERS

- ENSCO, Inc.
- Northern Plains Railroad Services
- FRA Office of Railroad Safety
- Volpe National Transportation Systems Center

COST & SCHEDULE

- Funding to Date (Phase I): $150,000
- Project Duration: September 2025 – September 2027

FRA PROJECT MANAGER: Jay Baillargeon • (719) 584-7155 • jay.baillargeon@dot.gov

Advancement in Rail Integrity Inspection

PROJECT DESCRIPTION

- **Advance the Rail Integrity Program at the FRA Transportation Technology Center (TTC)** by maintaining and expanding the Rail and Weld Flaw Library (RF-LOAD) and supporting both the Main and High-Speed Rail Defect Test Facilities (RDTF).
- **Expand the Metallurgy Laboratory** by acquiring and commissioning critical analytical equipment including an optical microscope, polishing and grinding equipment, updated hardness testers, Charpy impact tester, hot and cold mounting machines, and updated optical analysis software.
- **Metallurgy Laboratory capabilities** strengthen ENSCO's and FRA's ability to conduct metallurgical research, flaw characterization, and validate nondestructive evaluation (NDE) technologies.
- **Recharacterize and validate** rail and weld flaw samples, supporting ongoing FRA and Class I railroad collaboration for accurate flaw detection research.

RAILROAD IMPACT

- The expanded Metallurgy Laboratory and updated Rail and Weld Flaw Library will enhance TTC's ability to provide a foundation for detailed microstructural analysis and material performance assessments, improving knowledge of fatigue, and cracking behavior — all of which benefit the rail industry.
- By maintaining both the Main and High-Speed RDTF (supporting tests up to 80 mph), the program offers a unique national resource for railroads, technology developers, and researchers to safely test and calibrate inspection systems.
- These improvements directly support reductions in broken rail and weld-related derailments and strengthen industry confidence in emerging NDE inspection practices.

PROJECT PARTNERS

- ENSCO, Inc.
- North American Class I and short line/regional railroads

COST & SCHEDULE

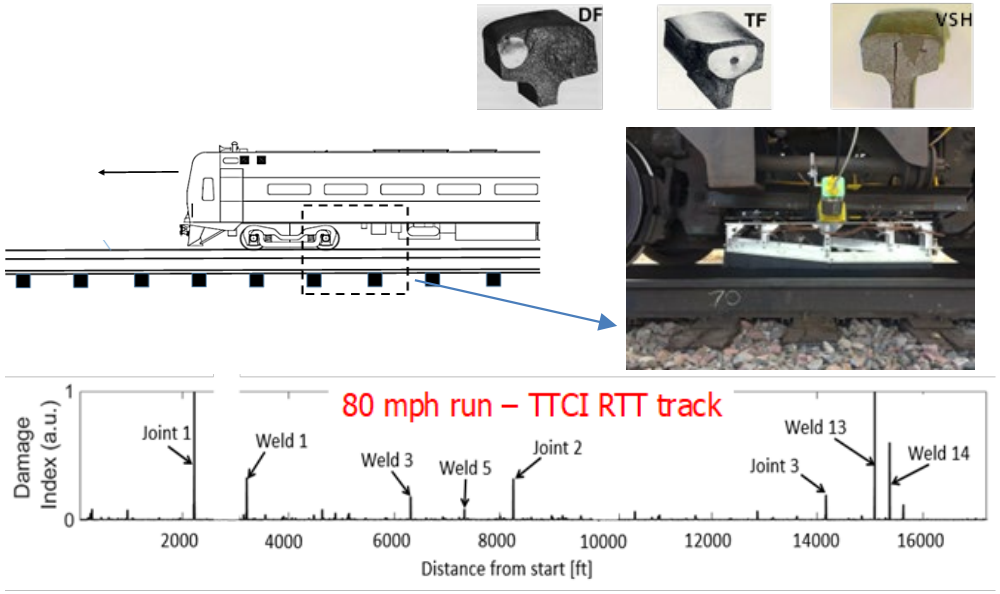
- Funding, Phase 2: $399,215
- Project Duration, Phase 2: September 2025 – September 2027

FRA PROJECT MANAGER: Megan Brice • (719) 601-7964 • megan.brice@dot.gov

Non-Contact Rail Inspection at Track Speed

PROJECT DESCRIPTION

- Develop a next-generation, non-contact system for rail inspection at track speed.
- Develop technology that uses lower ultrasonic frequencies (~kHz instead of ~MHz) to inspect defects under rail surface shelling.
- Analyze data from previous field tests conducted at speeds up to 40 mph at the Transportation Technology Center.
- Optimize aspects of the system such as mounting the sensing head underneath the car, cabling, electrical power, and data collection and storage.
- Conduct in-track testing of the prototype hardware and software on Class I railroad track.



RAILROAD IMPACT

- Minimize traffic disruptions and maximize probability of detection by using the redundancy of multiple tests over the same track and detecting internal rail flaws at track speed.
- Reduce derailments by detecting rail flaws such as detail fractures, transverse fissure, and vertical split heads that are responsible for train accidents and high damage costs.
- Improve the defect detection capability over current roller search units to improve the safety and efficiency of rail transportation.

PROJECT PARTNERS

- University of California, San Diego
- San Diego State University
- BNSF

COST & SCHEDULE

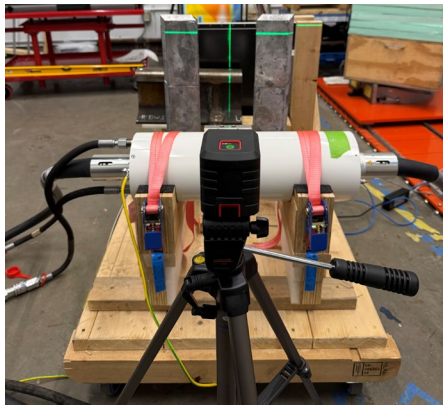
- Funding, Phase I: $223,936
- Project Duration, Phase I: June 2024 – May 2025

FRA PROJECT MANAGER: Megan Brice • (719) 601-7964 • megan.brice@dot.gov

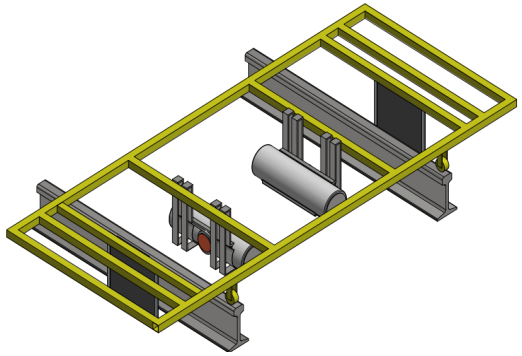
Advanced Radiographic Inspection of Rail Welds

PROJECT DESCRIPTION

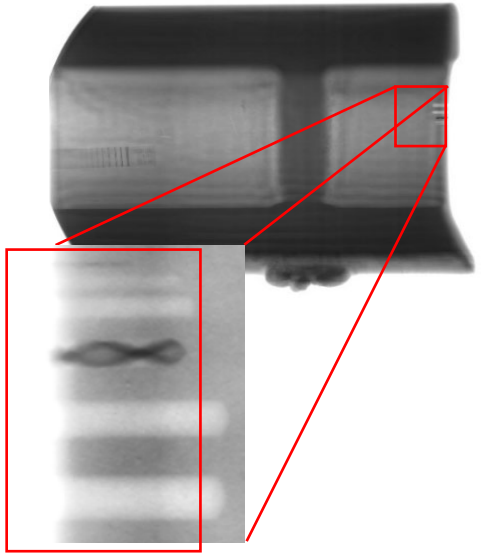
- Development of an advanced high-energy X-ray system with deeper penetration into the rail.
- Reliable method of detection of internal flaws providing high-resolution imaging for precision defect characterization.
- Construction of a unit to be mounted on a swingarm from the bed of a hi-rail truck.
- Demonstrate photon counting detector (PCD) capability for rail weld inspection.
- Develop image processing pipeline with scalability across critical infrastructure and a detailed design for deployment.



Experimental setup for rail weld inspection



Initial conceptual design (skeletal) of a dual in-track rail weld inspection unit



Processed radiograph of a flash-butt weld with a zoomed-in view (right) showing machined holes used as flaw surrogates, ranging from 0.5 mm (tungsten impurity) to 3 mm in diameter (top to bottom)

RAILROAD IMPACT

- Creation of a vast directory of rail weld images from every railroad and stakeholder to guide the development of weld grading standards and rail welding best practices.
- Deployment cost per year is less than the industry-wide consequences of broken welds per year.
- Instant feedback for hi-rail inspectors using a high-resolution digital detector array instead of the standard, slowly developing film or scanning a phosphor screen.
- Human error reduction due to automated computer grading methods that would pass or fail the weld and label any failures for team review.
- Relevant metadata (e.g., GPS, temperature, timestamp) accompanies each radiograph to enhance railroad safety and regulatory decision-making.

PROJECT PARTNER

- University of Tennessee, Knoxville

COST & SCHEDULE

- Funding, Phase I: $313,840
- Project Duration, Phase I: September 2025 – September 2026

FRA PROJECT MANAGER: Megan Brice • (719) 601-7964 • megan.brice@dot.gov

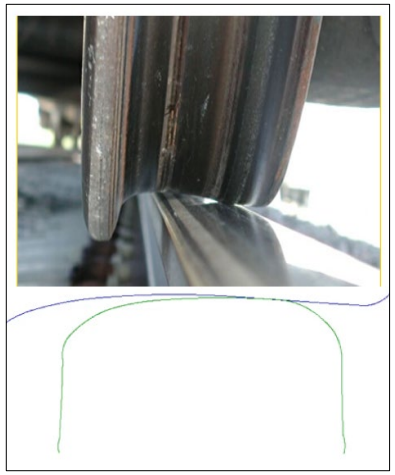
Development of a Computer Program RSQ to Signal Adverse Contact Conditions

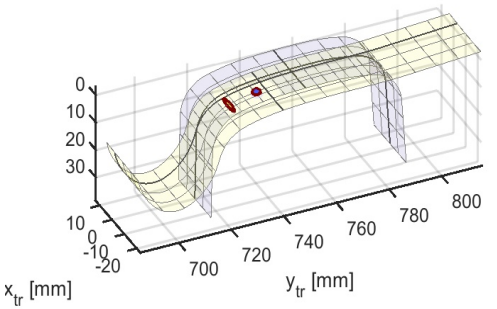
PROJECT DESCRIPTION

- Identify unfavorable vehicle-track interaction conditions as a function of rail profile geometry.
- Define and evaluate indicators for risk of derailment based on vehicle dynamic simulation.
- Develop an open-source Rail Shape Quality (RSQ) computer program that evaluates indicators for all combinations of given wheel and rail profile shapes.
- Select the most critical wheel profile shapes and introduce parallel computing to save computation time.
- Improve performance as needed for real-time application in autonomous inspection vehicles running at track speed.

RAILROAD IMPACT

- Provide quantitative indicators to identify adverse rail profile shapes with increased risk of derailment.
- Identify locations with adverse rail profile shapes from rail profiles measured at high density in automated track inspection.
- Improve track inspection and maintenance by prioritizing the problematic territories.





PROJECT PARTNERS

- Vtech CMCC
- Vehicle Dynamics Group LLC

COST & SCHEDULE

- Phase 1: Design proof of concept for the RSQ technology
- Phase 2: Improve scoring method and computational performance
- FY25 Funding: $179,200
- FY26 Funding (Option): $179,200
- Project Duration (Phase 1): August 2025 – August 2026

FRA PROJECT MANAGER: Abe Meddah • (719) 585-1809 • Abderrahmane.meddah@dot.gov

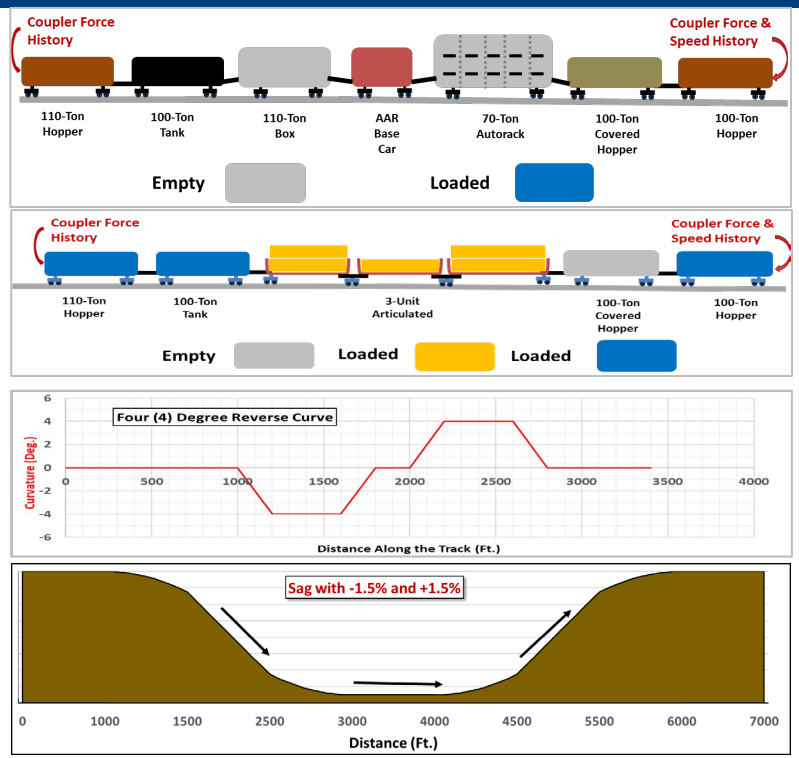
Track/Train Dynamic Simulations of Multi-Vehicle Consist

PROJECT DESCRIPTION

- This project will improve the state-of-the-art in computer modeling capabilities and practices in simulating train/track interactions using the railway specialized vehicle dynamics approach.
- Analytic development incorporates the links between the traditional detailed railway vehicle dynamics and longitudinal train action/dynamic models for simulations of train/track systems, capturing the effects of general tracks layouts, geometry defects, and wheel and rail profiles.
- The simulation methodology will enable a more accurate evaluation of train action events that affect vehicle dynamics, including wheel-climb and rail rollover L/V ratios, as well as wheel unloading and wheel-lift, which can ultimately lead to derailments.

RAILROAD IMPACT

- Comprehensive train derailment simulation capabilities.
- Improved vehicle dynamics and longitudinal train dynamics interaction.
- Improved simulation practices in train/track dynamics studies and derailment investigations.
- Reduced risk of train accidents and derailments.



PROJECT PARTNER

- Sharma & Associates, Inc.

COST & SCHEDULE

- Funding: $299,436
- Project Duration: July 2024 – January 2026

U.S. Department of Transportation
Federal Railroad Administration

FRA PROJECT MANAGER: Abe Meddah • (719) 585-1809 • Abderrahmane.meddah@dot.gov

Friction Modifier Modelling — Development and Implementation

PROJECT DESCRIPTION

- Enhance the current TOR product creep force model to improve its capability and implement it in a multi-body dynamics (MBD) environment.
- Reflection on previous project, product choice, identification of modelling scenarios, relevant tribological tests, and enhancement of model capability.
- Implement model in MBD environment (SIMPACK software).
- Model identified operational scenarios.

RAILROAD IMPACT

- With integration of model into vehicle-track interaction (VTI) simulations, this is a tool that can help define top-of-rail (TOR) product choice and application protocols.
- More accurate force prediction that will improve vehicle dynamics, wear, and rolling contact fatigue assessments.
- More accurate access charging information to help with creating the business case for TOR product application.

PROJECT PARTNERS

- University of Sheffield, UK
- Virtual Vehicle Research GmbH, Austria

COST & SCHEDULE

- Funding: $293,133
- Project Duration: September 2024 – March 2026

FRA PROJECT MANAGER: Abe Meddah • (719) 585-1809 • Abderrahmane.meddah@dot.gov

Autonomous Power-efficient Track Inspection System (APTIS)

PROJECT DESCRIPTION

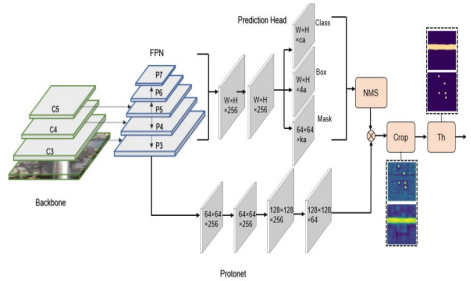
- Develop an autonomous, power-efficient, track inspection system.
- System is field-deployable and based on a mobile edge-computing device.
- AI-based track component level has real-time inspection capability.
- Low power consumption for different platforms.
- Fully autonomous and modular architecture design.
- Field-tested.

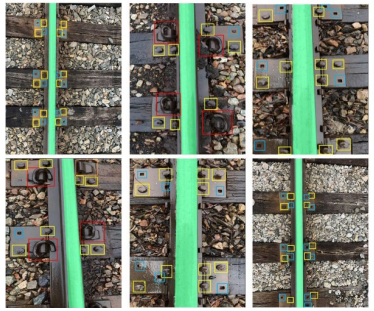
RAILROAD IMPACT

- Develop power-efficient system that can be integrated with existing vehicles for continuous inspection.
- Fully autonomous, highly efficient, and cost-conscious.
- Modular architecture design, easy to extend and adapt based on specific needs and interests in future development, customized inspection system.
- Assists condition-based track maintenance and improves track safety and operational efficiency.
- Benefits stakeholders in industry; railroad management; local, State, and Federal administrators; and legislators hoping to improve railroad operations.

Proposed Hardware System

Proposed Software System





PROJECT PARTNERS

- University of South Carolina
- CSX Transportation
- South Carolina Railroad Museum
- ENSCO, Inc.
- Michelin (licensee)

COST & SCHEDULE

- Funding: $599,782
- Project Duration: September 2021 – March 2026

FRA PROJECT MANAGER: Abe Meddah • (719) 585-1809 • Abderrahmane.meddah@dot.gov

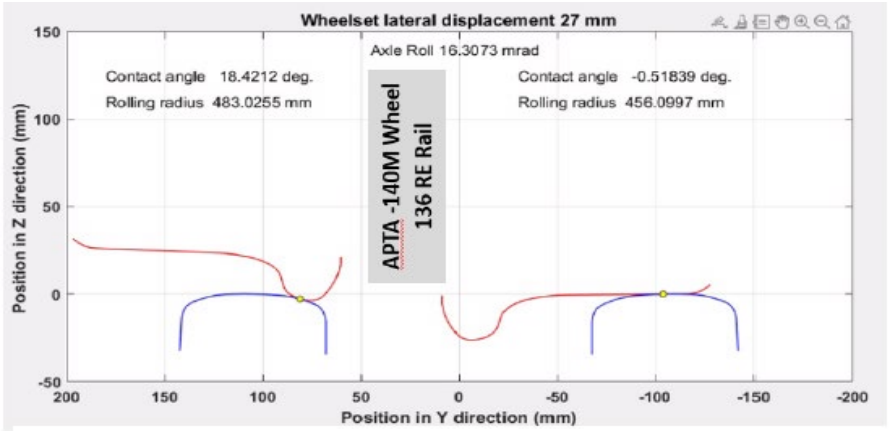
Estimating Derailment Index Based on Contact Conditions between a Representative Wheel and Measured Rail Profiles along the Track

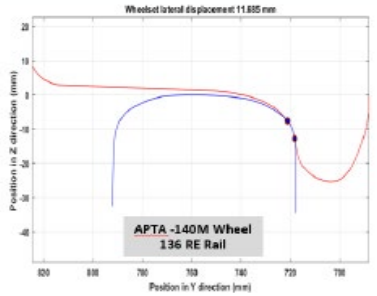
PROJECT DESCRIPTION

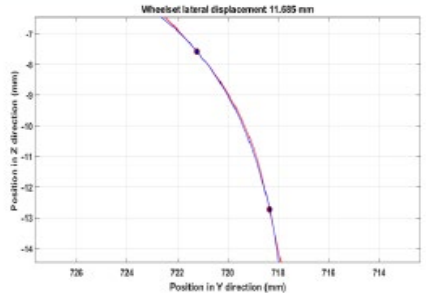
- Draft literature review and derailment characterization.
- Design software that automatically process and analyzes track geometry and rail profile data.
- Develop algorithm and safety assessment criteria for wheel-climb and rail rollover derailments and effective conicity analysis.
- Provide verification of the algorithm for selected track scenarios and given wheel(s) profile for derailment risk
- Produce final report.

RAILROAD IMPACT

- Enhanced effectiveness of track geometry inspection measurements for derailment risk.
- Usable in categorizing standard wheel-based interface with worn rails.
- Improved railroad operational safety.







PROJECT PARTNER

- Sharma & Associates, Inc.

COST & SCHEDULE

- Funding: $203,782 (Phase 1); $95,227 (Phase 2)
- Project Duration: September 2025 – March 2027

FRA PROJECT MANAGER: Abe Meddah • (719) 585-1809 • Abderrahmane.meddah@dot.gov

Improving Rail Adjustment Procedures through the Assessment of Longitudinal Rail Stress and Resistance at Critical Locations — Phase II

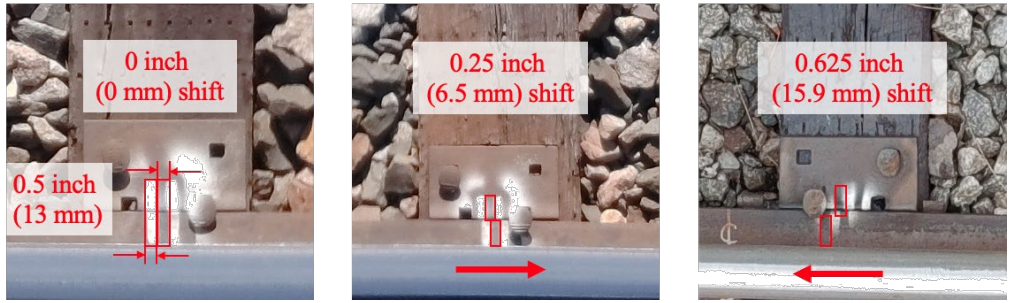
PROJECT DESCRIPTION

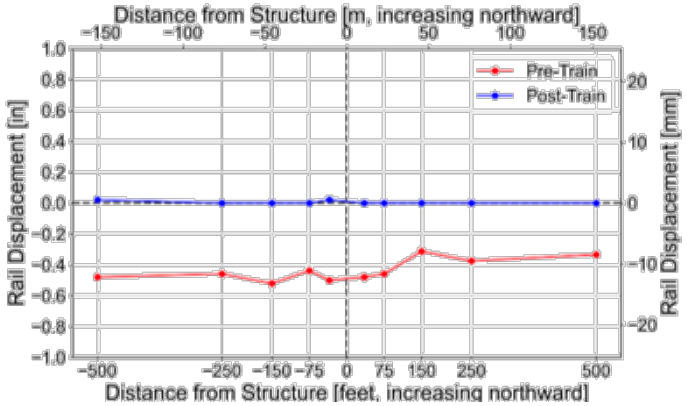
Overview:

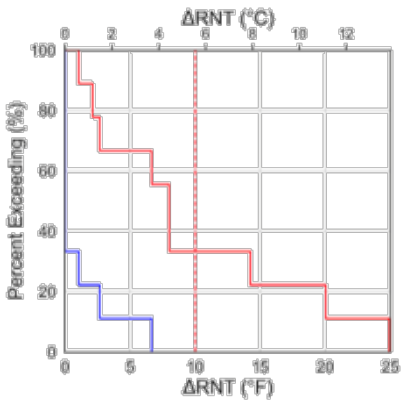
- Provide quantitative assessment of variables influencing differential axial stress influence zones to guide future rail stress adjustment practices.

Methods:

- What: Quantify how rail stress changes over time by monitoring longitudinal rail stress and differential rail displacement at structures and locations with limited de-anchoring.
- How: Use vision technologies (e.g., UAVs) to monitor longitudinal rail displacement (i.e., proxy for stress) over time.







RAILROAD IMPACT

- Improved rail safety and integrity and maintenance guidance during rail destressing.
- Improved inspection techniques for identifying differential rail displacement and/or stress.

PROJECT PARTNERS

- University of Illinois at Urbana-Champaign
- BNSF, CSX, Union Pacific Railroad

COST & SCHEDULE

- Funding (Requested): $245,000
- Project Duration: 18 months (2024 –2026)

FRA PROJECT MANAGER: Robert Wilson • (617) 999-0061 • robert.wilson@dot.gov

Improving CWR Management

PROJECT DESCRIPTION

- Provides a well-diversified research portfolio to advance longitudinal rail force technologies and management.
- Advancement of longitudinal rail force measurement technologies by facilitating university and private industry testing of new equipment through in-situ rail neutral temperature (RNT) monitoring sites.
- Improvement of CWR management practices in curves by investigating RNT behavior and refining break/cut management and movement control methods.
- Enhance rail break theory and CWR management guidelines for small gaps and low ΔT (RNT-rail temp) conditions.

RAILROAD IMPACT

- Increase track buckling safety through improved CWR management practices.
- Provide more accurate input and parameters for rail break theory implementations.
- Provide valuable RNT testing capabilities to researchers, industry professionals, and universities nationwide.
- Support the development of measurement equipment for rail longitudinal force in a realistic environment.

PROJECT PARTNERS

- ENSCO, Inc.
- Kandrew, Inc.

COST & SCHEDULE

- Funding to Date: $400,000 (Years 1 and 2)
- FY26 Funding (Option): $200,000
- FY27 Funding (Option): $200,000
- Project Duration: January 2025 – December 2028

FRA PROJECT MANAGER: Robert Wilson • (617) 999-0061 • robert.wilson@dot.gov

Track Engineering Assistance for Office of Railroad Safety

PROJECT DESCRIPTION

- Assist FRA Office of Research, Development, and Technology in conducting tests, detailed analyses and technical reviews on behalf of the Office of Railroad Safety to ensure the safety of the U.S. railroad network.
- Efforts can include analyses to ensure appropriate and justifiable regulations as well as support for efforts focused on railway infrastructure, passenger safety, and freight accident prevention.
- Support the theoretical development of CWR management methodologies and expand CWR training.

RAILROAD IMPACT

- Task provides for quick response instrumentation, testing, and analysis support to resolve safety-related problems and emergencies, determine causal factors, and reduce future problems.
- Supports data-gathering for high speed/high cant deficiency qualification and revised safety standards reflecting sound science and engineering expertise.
- Facilitates ongoing technical evaluation required for demonstration and deployment of new technologies for improved safety and operational efficiency.
- Training material for CWR management developed under this task will serve as a resource for the rail industry.

PROJECT PARTNERS

- ENSCO, Inc.
- Kandrew, Inc.

COST & SCHEDULE

- Funding to Date: $284,997 (Years 1 and 2)
- FY26 Funding (Option): $135,000
- FY27 Funding (Option): $135,000
- Project Duration: January 2025 – December 2028

FRA PROJECT MANAGER: Robert Wilson • (617) 999-0061 • robert.wilson@dot.gov

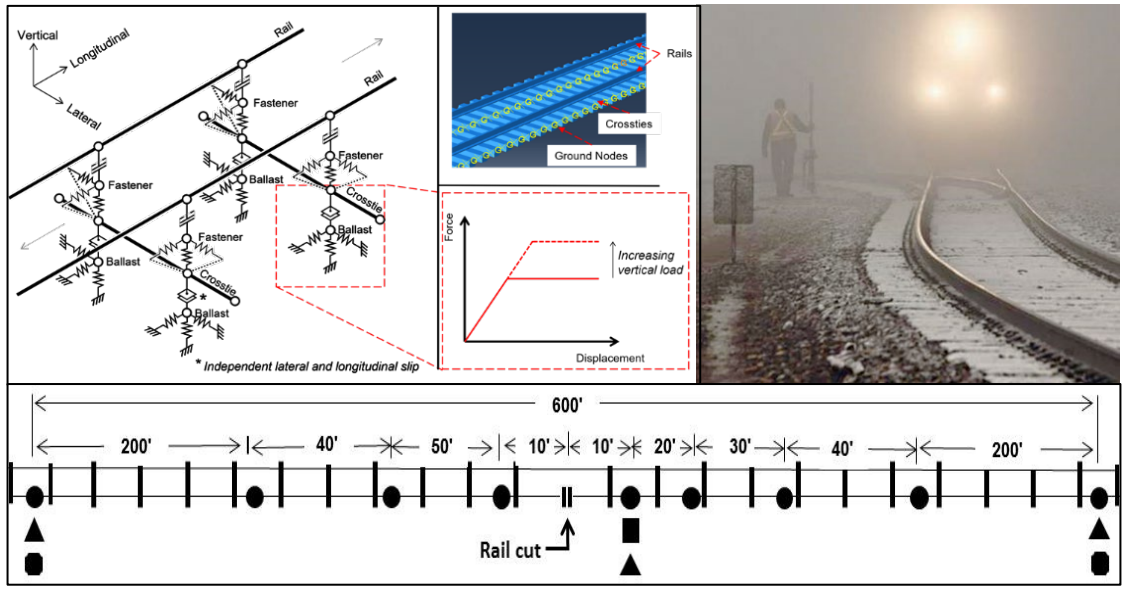
Investigation of the Effects of Frozen Ballast on RNT Loss and RNT Remediation

PROJECT DESCRIPTION

- Investigate RNT behavior in frozen ballast conditions.
- Improve applicability of current rail break mechanics by determining the values of longitudinal rail restraint in frozen conditions.
- Conduct laboratory testing to determine parameters that quantify the capacity for frozen ballast.
- Update previously developed FRA 3D track model to account for frozen ballast conditions.
- Propose new recommended practices aimed at improving RNT management.

RAILROAD IMPACT

- Proper consideration of frozen ballast conditions in future countermeasures developed to prevent and mitigate the potential for derailments in cold-weather regions.
- New remediation strategies and RNT adjustment recommendations that account for the effects of frozen ballast and can be implemented into existing RNT management plans.
- Improved understating of rail break mechanics in cold weather conditions.
- Decreased risk of track buckle derailments caused by improper RNT adjustments.



PROJECT PARTNERS

- ENSCO, Inc.
- University of Illinois at Urbana-Champaign
- Kandrew, Inc.

COST & SCHEDULE

- Funding: $499,958
- Project Duration: August 2023 – August 2026

U.S. Department of Transportation
Federal Railroad Administration

FRA PROJECT MANAGER: Robert Wilson • (617) 999-0061 • robert.wilson@dot.gov

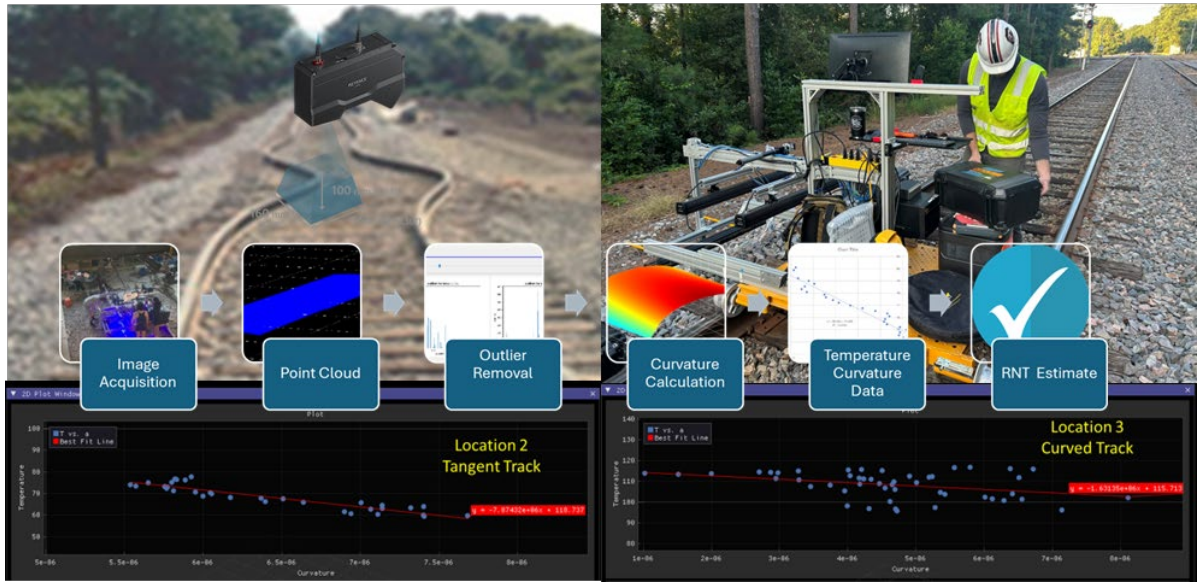
SBIR — Mobile, Non-Contact System for RNT and Rail Stress Measurements — Phase 1

PROJECT DESCRIPTION

- Establish the commercial viability and competitiveness of the prototype system developed at USC. The USC technology is a proven methodology and measurement system for estimating the rail neutral temperature (RNT) and computing the longitudinal stress
- Transfer the technical expertise from the USC inventors to Insight Rail.
- Develop first-generation commercial prototype and demonstrate technology performance through high-fidelity laboratory testing and digital twin parametric studies.
- Define customer demands and expectations through partnerships with end client.
- Identify suppliers to produce the pre-production prototype for Phase II activities.

RAILROAD IMPACT

- Market-ready mobile system for RNT and rail stress measurements based on fundamental principles of mechanics and science.
- Facilitate effective management of thermal stresses.
- In-situ, non-destructive, reference-free testing; does not disrupt service.
- Simple, easy to use, accurate, and cost-effective technology acquires RNT within 5ºF in less than 10 minutes per location by a 2-member crew.
- Facilitates rail assessment either in a spot-check mode, or semi-continuous mode at a rate of ¼ mile of track per hour.
- Produces data that can be stored in a spatial temporal database and fused with information acquired by other track sensing technologies for monitoring RNT changes over time.



PROJECT PARTNERS

- Insight Rail, LLC.
- University of South Carolina
- Ripple Technology, LLC

COST & SCHEDULE

- FY25 Funding: $199,961
- Project Duration: August 2025 – February 2026

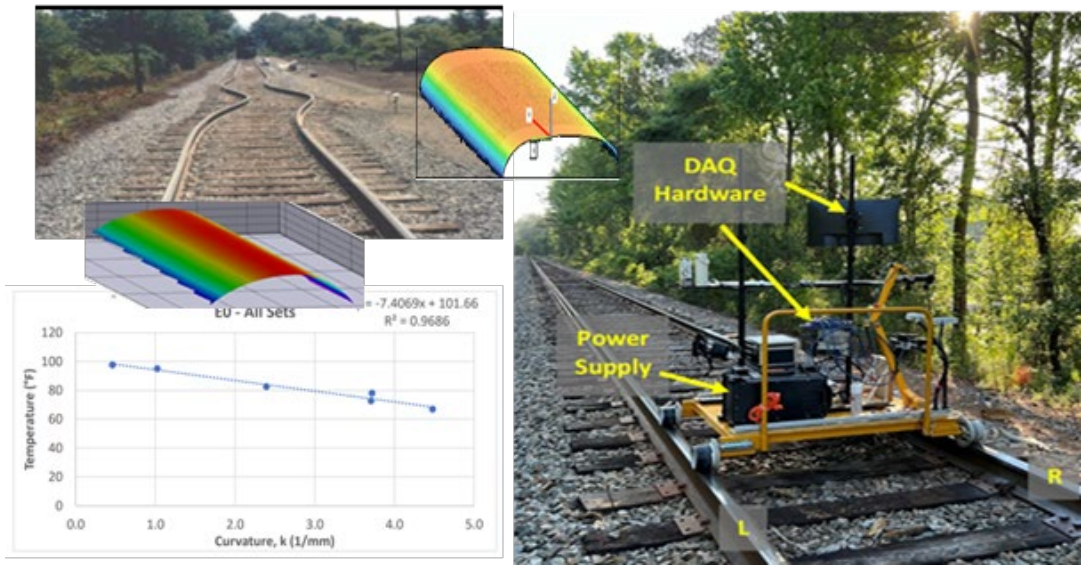
U.S. Department of Transportation
Federal Railroad Administration

FRA PROJECT MANAGER: Robert Wilson • (617) 999-0061 • robert.wilson@dot.gov

Qualification of a Mobile, Non-Contacting System for RNT and Longitudinal Rail Stress Measurements

PROJECT DESCRIPTION

- Develop, deploy, test and qualify the second-generation prototype system that implements a proven methodology and measurement system for estimating the rail neutral temperature (RNT) and computing the longitudinal stress
- Develop new generation hardware of mobile, on-track system based on stereoDIC and/or 3D laser scanner technology for full-field deformation measurements of rail.
- Develop new generation software that implements the novel, reference-free algorithm for RNT and stress calculations and enables automation within a GUI environment.
- Validate and qualify system at TTC-ENSCO and/or field where RNT is known or can be measured; deploy, test, and demonstrate in the field under various track parameters and operating conditions and acquisition modes.



RAILROAD IMPACT

- Improve safety through the early detection of potential rail failures.
- Facilitate effective management of thermal stresses
- In-situ, non-destructive, reference-free testing; does not disrupt service.
- Simple, easy to use, accurate, and cost-effective technology deployed on a routine basis or on-demand.
- Ability to integrate data with information acquired by other trac-sensing technologies.

PROJECT PARTNERS

- University of South Carolina
- Correlated Solutions, Inc.
- CSX

COST & SCHEDULE

- FY24 Funding: $193,026
- FY25 Funding: $205,187
- Project Duration: September 2024 – September 2026

FRA PROJECT MANAGER: Robert Wilson • (617) 999-0061 • robert.wilson@dot.gov

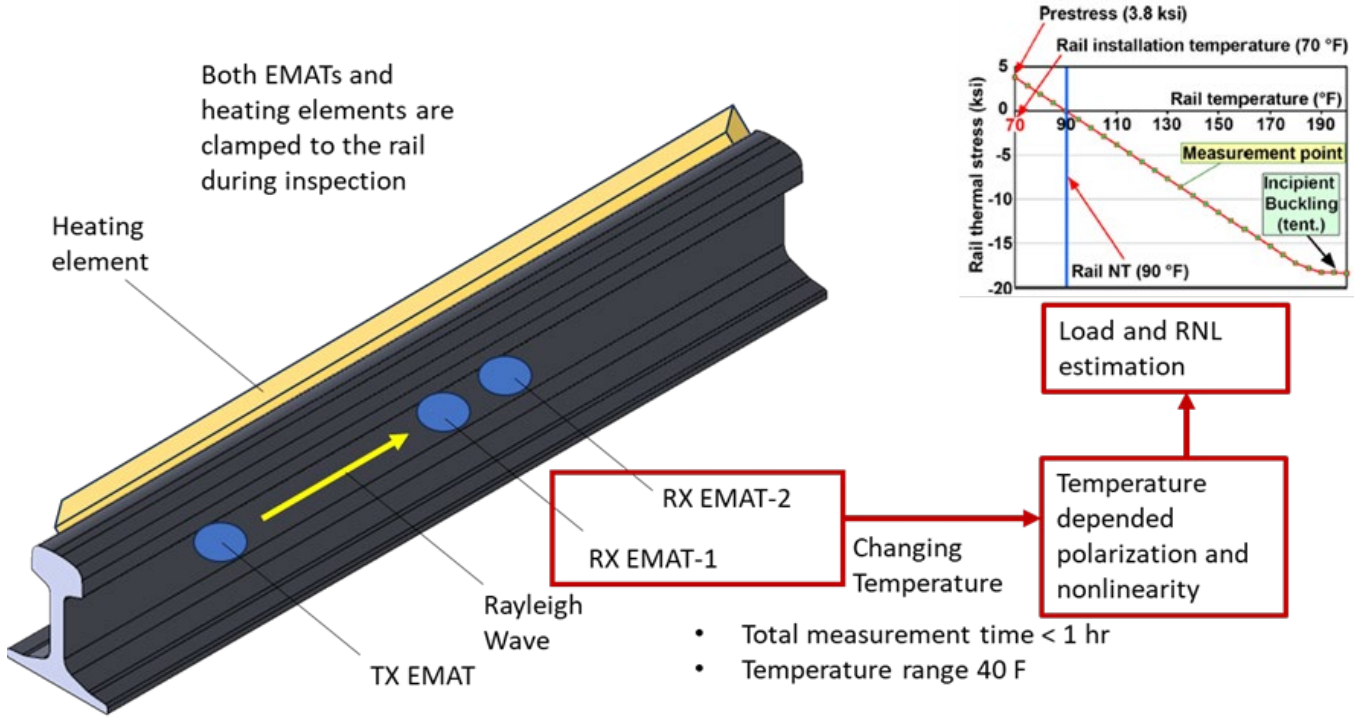
Non-Contact Ultrasonic System for Measuring Rail Neutral Temperature

PROJECT DESCRIPTION

- Clamp-on ultrasonic system with active heating for rapid rail neutral temperature (RNT) detection.
- Key Components:
  - EMAT Module: generates and detects Rayleigh waves; monitors polarization & higher-harmonic signals.
  - Active Heating Element: raises rail temperature (e.g., +40°F) to force neutral point crossing.
  - Data Analysis and Display Interface: processes waveforms in real-time; identifies RNT via nonlinear coefficient (β) and polarization (Π).

RAILROAD IMPACT

- Improves rail safety by preventing buckling and fractures.
- Enables rapid, non-contact RNT measurements.
- Supports predictive maintenance and FRA compliance.
- Reduces costs and enhances worker safety.
- Scales for network-wide rail stress monitoring.



PROJECT PARTNER

- X-Wave Innovations

COST & SCHEDULE

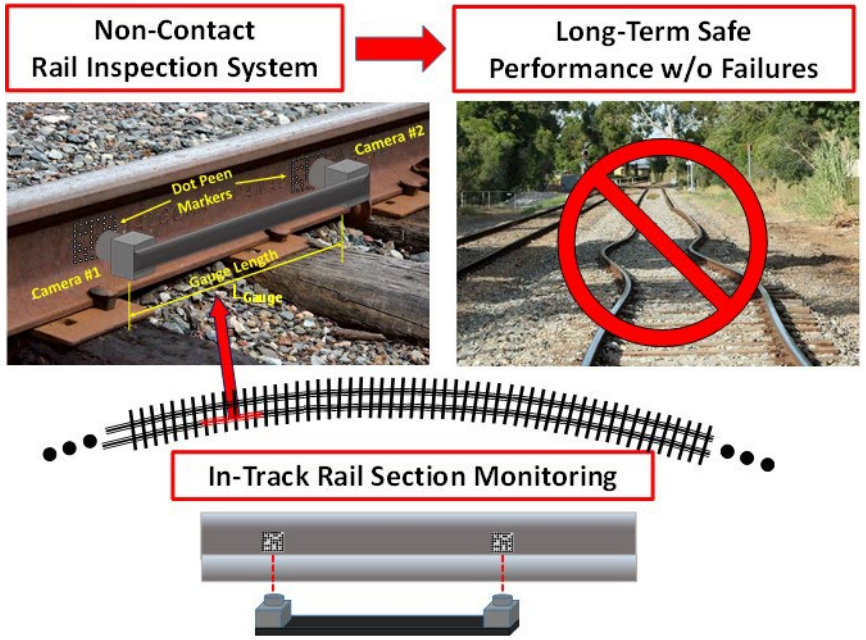
- Funding to Date (Phase I): $199,999.98
- Project Duration: August 20, 2025 – February 19, 2026

FRA PROJECT MANAGER: Robert Wilson • (617) 999-0061 • robert.wilson@dot.gov

In-Track Measurement of the State of Stress in Steel Rail

PROJECT DESCRIPTION

- Use existing sensor technology (proven laser speckle imaging [LSI] system).
- Modify sensor to provide extended gage length and optimize for use on steel rail.
- Use dot peen “rail markings” as tag for displacement (strain) measurements.
- Fabricate and calibrate the sensor.
- Design a special rail test frame to demonstrate the procedure and verify the accuracy of the test method.
- Fabricate the rail test frame.
- Conduct full-scale tests and troubleshoot errors.
- Conduct field tests in-track at BNSF.
- Produce the final report.



RAILROAD IMPACT

- Improve safety by reducing risk of in-track failures due to breakage or buckling.
- Identify severe departures from rail neutral temperature.
- Enable railroads to predict the progressive and/or sudden failure of track structures.
- Application of technology to be fully developed into a routine track inspection tool.
- Long-term capability to monitor state of in-track rail stress and identify at-risk areas.

PROJECT PARTNERS

- Kansas State University
  - KSU Technology Development Institute
- BNSF
- FRA Office of Railroad Safety

COST & SCHEDULE

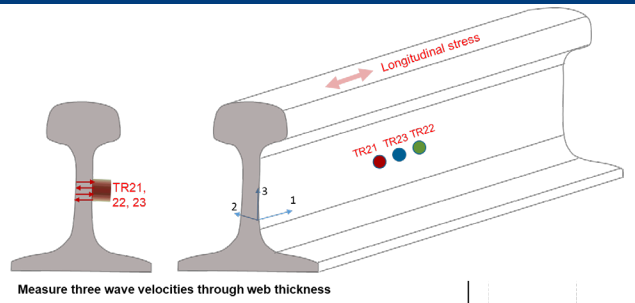
- Funding: $306,154
- Project Duration: August 2024 – August 2026

FRA PROJECT MANAGER: Robert Wilson, Ph.D. • (617) 999-0061 • robert.wilson@dot.gov

Self-referenced Ultrasonic System for Measuring Longitudinal Rail Stress

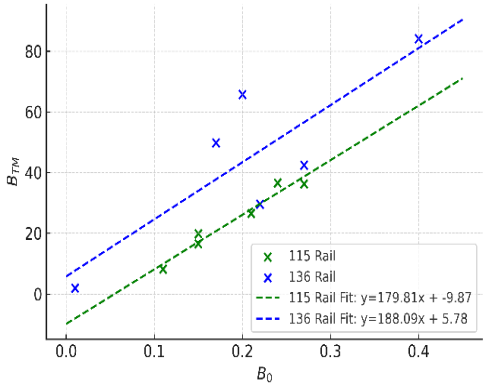
PROJECT DESCRIPTION

- **Objective**: Develop a self-referenced ultrasonic testing system to measure longitudinal stress in rail based on acoustoelastic effect.
- Use shear wave birefringence (velocity difference) between V_{21} and V_{23} to evaluate longitudinal stress.
- Temperature effect will be corrected.
- Initial anisotropy (B_0) due to residual stress will be evaluated in-situ using thermal modulation method (B_{0TM}).
- **Phase I:** Completed a feasibility study in laboratory and built relationship between B_0 and B_{0TM}. Acoustoelastic coefficient m_1 was measured with high confidence.
- **Phase II:** Build a prototype, validate the concept at TTC, improve the accuracy and sensitivity, and develop a portable NDE system for field application.



Measure three wave velocities through web thickness

Rail Type	R^2	m_1 (1/Mpa)
115RE	0.989	8.721×10^{-6}
136RE(A)	0.999	8.867×10^{-6}
136RE(B)	0.996	9.077×10^{-6}
Average		8.883×10^{-6}



RAILROAD IMPACT

- Measure longitudinal stress using nondestructive test method without reference.
- Predict in-place RNT without cutting the rail.
- Reduce derailment related to thermal stress induced rail bucking or pull-a-part failure.
- Increase safety through technological development.

PROJECT PARTNERS

- University of Nebraska-Lincoln (C-STTAR member)
- ENSCO, Inc.

COST & SCHEDULE

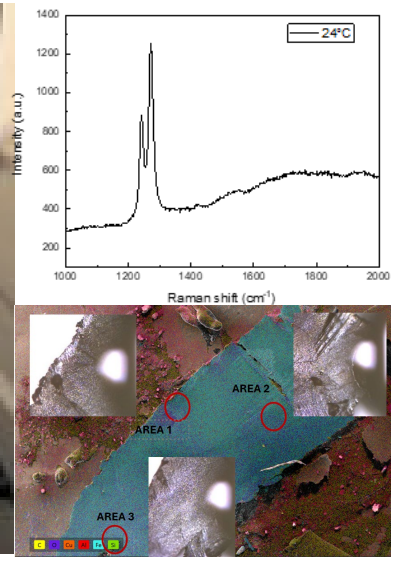
- FY25 Funding (Phase I): $164,953
- FY26 Funding (Option): $157,811
- Project Duration: October 2024 – September 2027

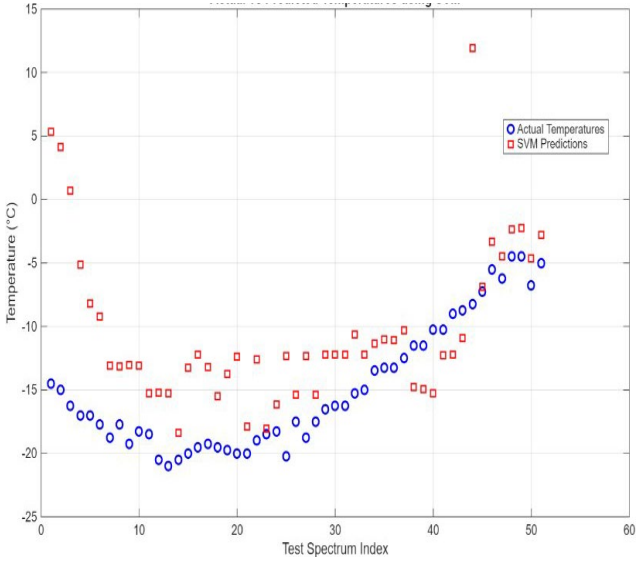
PROJECT MANAGER: Robert Wilson • 617-999-0061 • robert.wilson@dot.gov

Neutral Temperature Determination Using Reliable Pressure Sensing Ceramics

PROJECT DESCRIPTION

- Development of accurate, alumina-based (e.g., ruby, sapphire) pressure-sensing ceramics to monitor stress in rails which can lead to buckled track derailments.
- Determine residual stress buildup determination.
- Determine rail state of linear stresses.
- Correlate among temperature, stresses, and ruby resonant band's shift.
- Develop machine learning algorithms.





RAILROAD IMPACT

- The project develops a rail buckle and pull-a-part prevention monitoring technology.
- The technology will be robust and survivable in the harsh railroad environment.
- Improve safety and efficiency.
- Prevent derailments.

PROJECT PARTNERS

- University of Houston
- ENSCO, Inc.

COST & SCHEDULE

- Funding: $187,103
- Project Duration: September 2024 – September 2026

PROJECT MANAGER: Robert Wilson • 617-999-0061 • robert.wilson@dot.gov

SECTION TWO

ROLLING STOCK

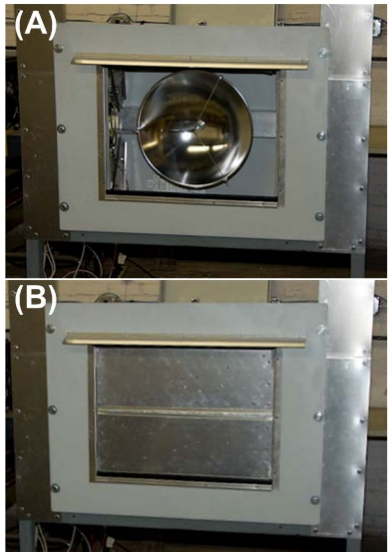
IEM Advanced Acoustic Bearing Monitor (AABM)

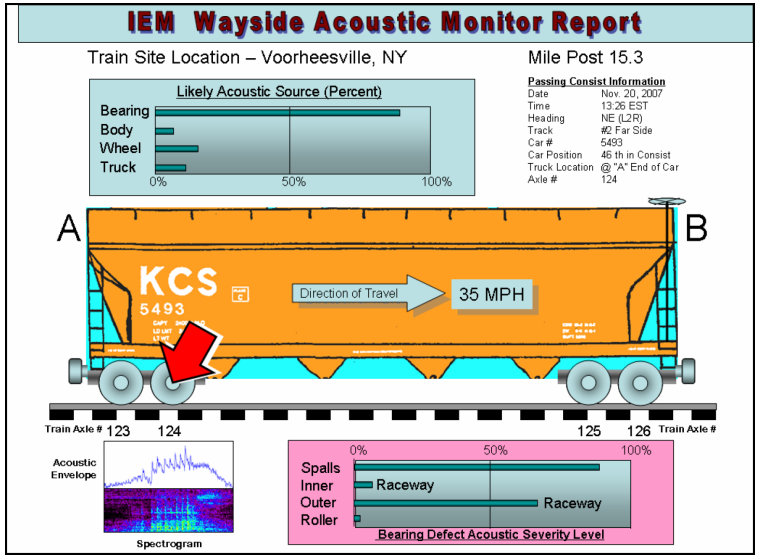
PROJECT DESCRIPTION

- The AABM acquires high-bandwidth, targeted acoustic data from each passing wheel and bearing.
- Smart signal analysis, deep learning, and expert system inputs detect, measure, localize, and evaluate severity of bearing flaws and potentially others, such as wheel flats.
- Parabolic microphone and key processing allows small enclosures and far (up to 30') setbacks from track.
- Accumulates data on repeated measurements.
- Operates at mainline speeds (up to 130km/hr).
- This project builds upon 30+ years of experience in wayside and in-ground system design and acoustic and complex signal analysis.

RAILROAD IMPACT

- Permits condition-based maintenance of bearing flaws with more faster and more accurate detection.
- Detects potential bearing flaws well before accidents. prevents dangerous and expensive derailments.
- Provide the safety, monetary, and time savings inherent in predictive health maintenance.
- Detects other faults including slid flats, anomalous vibrations, etc.
- Enables predictive bearing and wheel maintenance.





PROJECT PARTNERS

- International Electronic Machines Corp.
- Freight rail industry and stakeholders
- Transit rail operators

COST & SCHEDULE

- FY24 Funding: $453,305
- Project Duration: September 2024 – September 2026

FRA PROJECT MANAGER: David C. Brabb • (719) 500-9400 • david.brabb@dot.gov

Development of Fire Test Facilities

PROJECT DESCRIPTION

- This effort seeks to investigate fire testing needs in the railroad -industries, develop plans for such test facilities, and to further develop the test facilities at the FRA Transportation Technology Center via a multi-phase effort. Key tasks include:
  - Review of fire testing needs and existing gaps in the U.S. testing infrastructure.
  - Development of plans for small-scale and full-scale fire test facilities.
  - Implement a small-scale test setup and demonstrate its functionality.
  - Update plans for large test facility based on results of demonstration test.

RAILROAD IMPACT

- Test facilities to verify fire safety performance for tank cars, hazmat vehicles, and emerging propulsion technologies — including batteries.
- Test facilities to evaluate emergency protocols and mitigation strategies.
- Reduced risks to railroads, employees, and public from better quantification and reduction of fire-related risks; increased safety in train operations.
- Better understanding of various train components when subjected to fire.

PROJECT PARTNERS

- Sharma & Associates, Inc.

COST & SCHEDULE

- FY24 Funding: 349,547
- Project Duration: September 2024 – May 2026

PROJECT MANAGER: David C Brabb • 719-500-9400 • david.brabb@dot.gov

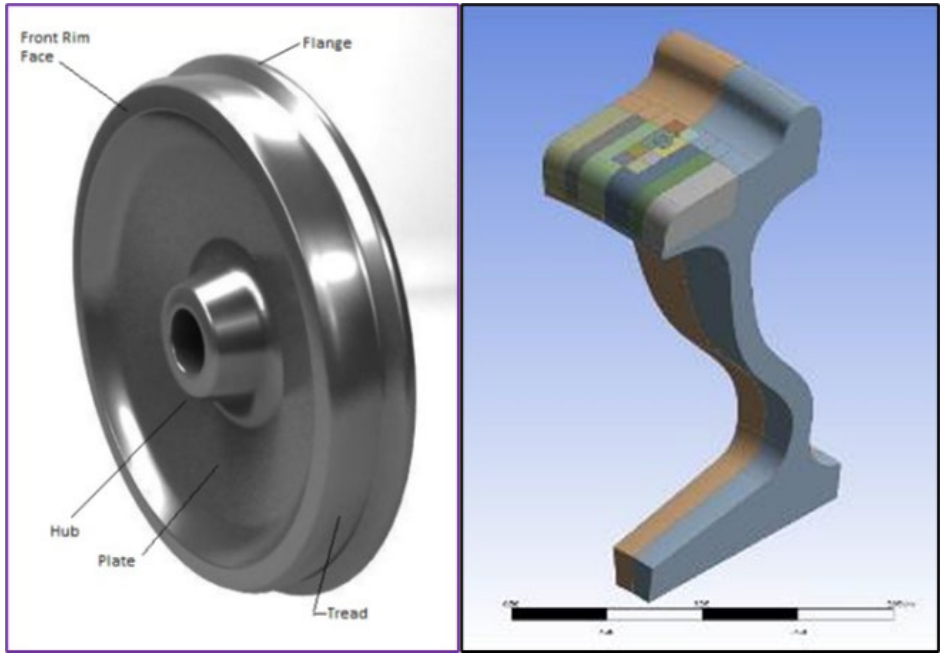
Wheel Failure R&D Program Support Continuation

PROJECT DESCRIPTION

- Multi-phase wheel research program to study and investigate wheel failure mechanisms and develop strategies to mitigate or eliminate wheel failures.
- Created an industry Stakeholder Working Group, made up of members of the Association of American Railroads, car owners, and researchers.
- Established current industry understanding for both vertical split rail (VSR) and shattered rim failures.
- Further analysis of the VSR wheel failure problem using the FEA-based approach proven successful in the previous phase; explore decreasing carbon content upper limits and microalloying.

RAILROAD IMPACT

- Increased railroad operational safety due to fewer wheel failure derailments.
- Fewer wheel failure derailments that include VSRs.
- Reduced railroad costs due to reduced vehicle and track damage and delays.
- Better railroad understanding of wheel defects, metallurgy, and outside influences that can contribute to damage.



PROJECT PARTNERS

- ENSCO, Inc.
- Railroad industry and stakeholders

COST & SCHEDULE

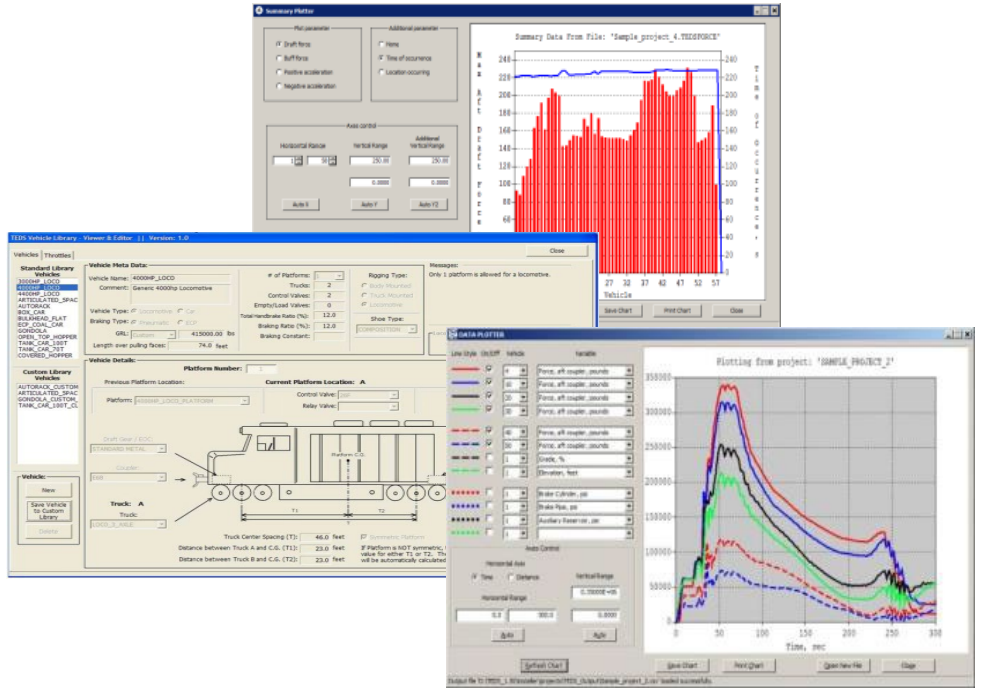
- FY24 Funding: $469,920
- Project Duration: September 2024– March 2026

FRA PROJECT MANAGER: David C. Brabb • (719) 500-9400 • david.brabb@dot.gov

Train Energy and Dynamics Simulator (TEDS) Enhancements and Maintenance

PROJECT DESCRIPTION

- TEDS is a computer program developed by FRA for conducting longitudinal train dynamics simulations.
- It can assist in the development of guidelines and recommendations to improve train handling and operational safety.
- TEDS can simulate train handling, train makeup, head-end and distributed power, ECP, and automatic brake applications for speed control, stopping distances, and emergency stops.
- Published validation details can be found in an FRA Technical Report.
- It has been used successfully for several simulations to assist FRA's Office of Railroad Safety in various incident investigations.
- TEDS is available for public use under a service agreement with FRA and Sharma & Associates, Inc.



RAILROAD IMPACT

- TEDS can assist derailment/incident investigations.
- TEDS facilitates the simulation of train operation safety risk affected by:
  - Train makeup and train handling.
  - Certain types of malfunctioning equipment, such as locomotive power issues, malfunctioning airbrake equipment, and mechanical running gear issues.

PROJECT PARTNER

- Sharma & Associates, Inc.

COST & SCHEDULE

- FY24 Funding: $400,000
- Project Duration: September 2024 – September 2026

FRA PROJECT MANAGER: David C. Brabb • (719) 500-9400 david.brabb@dot.gov

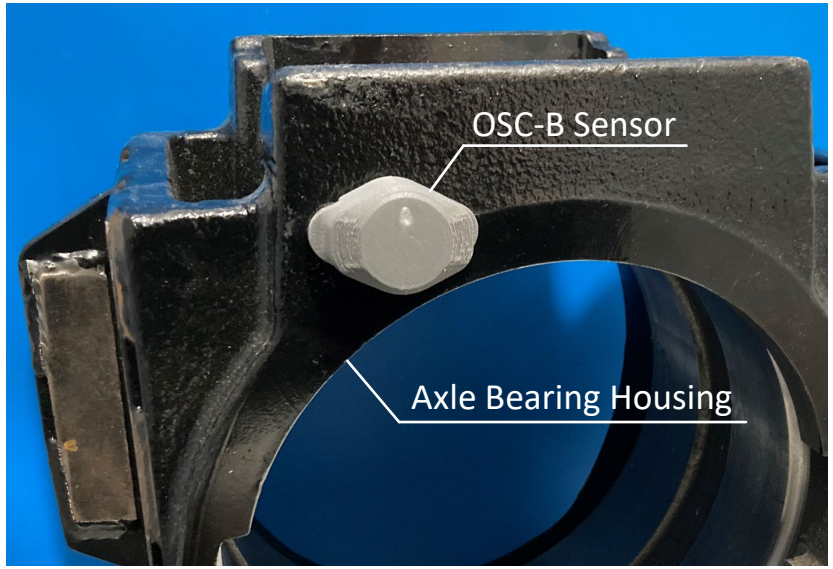
Onboard Sensing and Communication System for Bearing Monitoring (OSC-B): SBIR Phase IIB

PROJECT DESCRIPTION

- Develop a novel, onboard wireless sensing and communication (OSC) system for continuous monitoring of train axle bearings and real-time detection/warning of failure.
- Design and fabricate battery-powered compact wireless sensor for temperature and vibration monitoring.
- Formulate a sensor fusion algorithm for reliable early detection of bearing failure.
- Create a wireless network and cloud computing for remote monitoring and alerts.

RAILROAD IMPACT

- Address critical needs for detecting axle bearing failures that frequently cause train derailments.
- The OSC system offers a significant advantage over the current intermittent wayside monitoring system.
- The OSC has potential for comprehensive safety monitoring and operational improvement.
- Improves train safety while providing cost saving by preventing accidents.



PROJECT PARTNERS

- Newport Sensors, Inc.
- Massachusetts Bay Transportation Authority

COST & SCHEDULE

- FY24 Funding: $399,680
- Project Duration: April 2024 – April 2026

U.S. Department of Transportation
Federal Railroad Administration

FRA PROJECT MANAGER: David C. Brabb • (719) 500-9400 • david.brabb@dot.gov

Very Long Train Study: Follow-On Efforts and Testing

PROJECT DESCRIPTION

- This effort includes simulations to evaluate very long train (VLT) performance with various difficult-to-test and non-ideal equipment, environments, and operating conditions.
- Two additional revenue service tests using the eight instrumented box cars will be conducted, potentially including:
  - Eastern railroad
  - Mixed manifest train
  - Cold weather conditions
- Efforts to be guided by a test review committee with participants from the regulators, railroads, railroad labor, and vendors.
- Prior efforts evaluated the performance VLTs as a multi-phase study with laboratory tests, stationary train tests, and one moving train test.
  - However, all combinations of non-ideal conditions could not be covered by the tests due to safety and practicality reasons.

HE: L-133-L-67		Actual Flow [SCFM]	Gradient [psi]
Natural	Phase 3	<20	0.5
	Phase 3-TEDS	12	0.3
60 SCFM	Phase 3	68	1.9
	Phase 3-TEDS	68	1.8
90 SCFM	Phase 3	102	2.9
	Phase 3-TEDS	102	3
140 SCFM	Phase 3	157	7.5
	Phase 3-TEDS	158	7.6

RAILROAD IMPACT

- Create a common understanding of VLT performance among stakeholders.
- Improve train air brake and longitudinal dynamic performance data on VLT trains.
- Improve train dynamics simulation capabilities to study train operation in general and VLT operations for non-testable conditions.

PROJECT PARTNERS

- Sharma & Associates, Inc.
- Test Review Committee, including industry

COST & SCHEDULE

- FY24 Funding: $432,800
- Project Duration: August 2024 – August 2026

FRA PROJECT MANAGER: David C. Brabb • (719) 500-9400 david.brabb@dot.gov

Next Generation End of Train (EOT) Development and Testing for Railroad Safety

PROJECT DESCRIPTION

- Develop a next-generation end-of-train (EOT) system that enhances the reliability, safety, and resilience of train operations, especially for long trains.
- Develop advanced communication, braking, and power management solutions.
- Integrate multi-channel communication redundancy, fail-safe emergency braking enhancements, and a modular power system design
- Mitigate risks associated with EOT-related communication failures and mechanical malfunctions.
- This is a 6-month proof-of-concept project funded through an SBIR grant.

RAILROAD IMPACT

- The enhanced design and components will mitigate communication disruptions caused by radio interference and terrain obstacles that can block critical commands from reaching the EOT unit.
- The system will address power failures caused by extreme environmental conditions which render an EOT device inoperable.
- The design will use robust subsystems that drastically reduce braking reliability risks caused by failures in both primary and backup solenoids or a system having flawed fail-safe logic that can reduce emergency braking dependability.

Aerial photograph of a train accident with EOT failure as a contributory cause. (NTSB)

PROJECT PARTNER

- Redstone Technologies LLC

COST & SCHEDULE

- FY25 Funding: $199,894
- Project Duration: August 2025 – February 2026

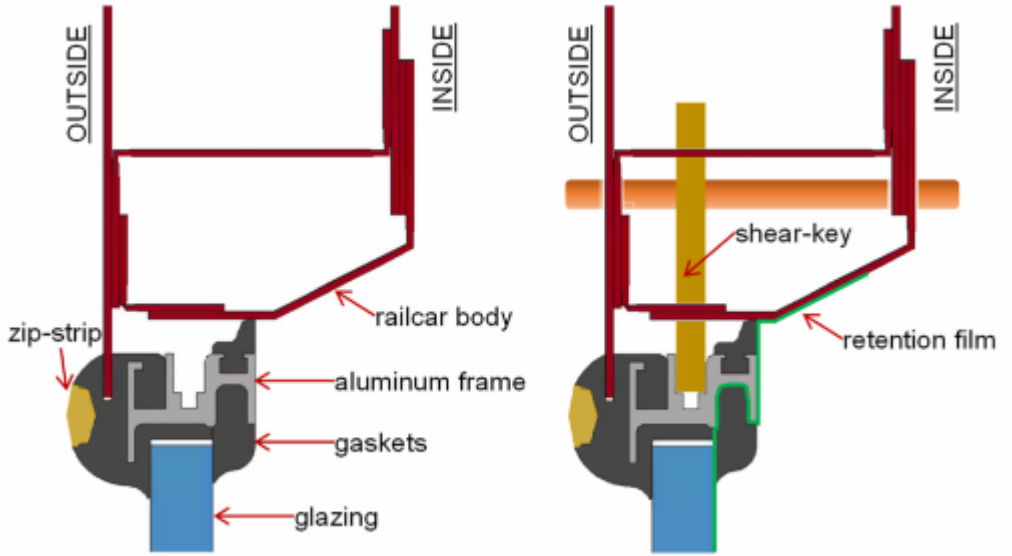
U.S. Department of Transportation
Federal Railroad Administration

FRA PROJECT MANAGER: Kevin B. Myles• (771) 233-3117 • kevin.myles@dot.gov

Novel Design for Passenger Railcar Retention Systems

PROJECT DESCRIPTION

- Demonstrate proof-of-concept implementations of the two novel window securement methods developed in Phase I.
- The project will include series of static load tests to measure loads required to dislocate glazing from the railcar body frame. Testing will be performed both with and without the subject window securement designs.
- The proof-of-concept will include high-fidelity pre-test and post-test models to support and validate the planned experiments, post-test model validation using test data, and the use of enhanced numerical realism for rollover-type derailment loading using meshless methods to model ground surfaces (soil and ballast).
- One project goal is to have the final feasibility of the securement systems demonstrated numerically.



RAILROAD IMPACT

- For the rail industry, the project will finalize the development of a robust commercialization strategy, including a roadmap for market delivery of the systems designed.
- The new window securement systems will reduce the passenger injuries and fatalities that can increase in rollover-type derailments when glazing retention mechanisms fail.
- The novel design will address the common rail passenger car window failure mode of the external rubber gaskets that secure the glazing to the railcar frame shearing off, causing the glazing to get pushed into the car and creating openings through which passengers can be ejected.
- The design will satisfy the challenge presented by FRA to develop concepts that avoid reliance on traditional securement methods to enhance glazing retention in rollover-type derailments while also complying with FRA safety regulations for emergency exit windows and emergency access windows.

PROJECT PARTNER

- Protection Engineering Consultants LLC

COST & SCHEDULE

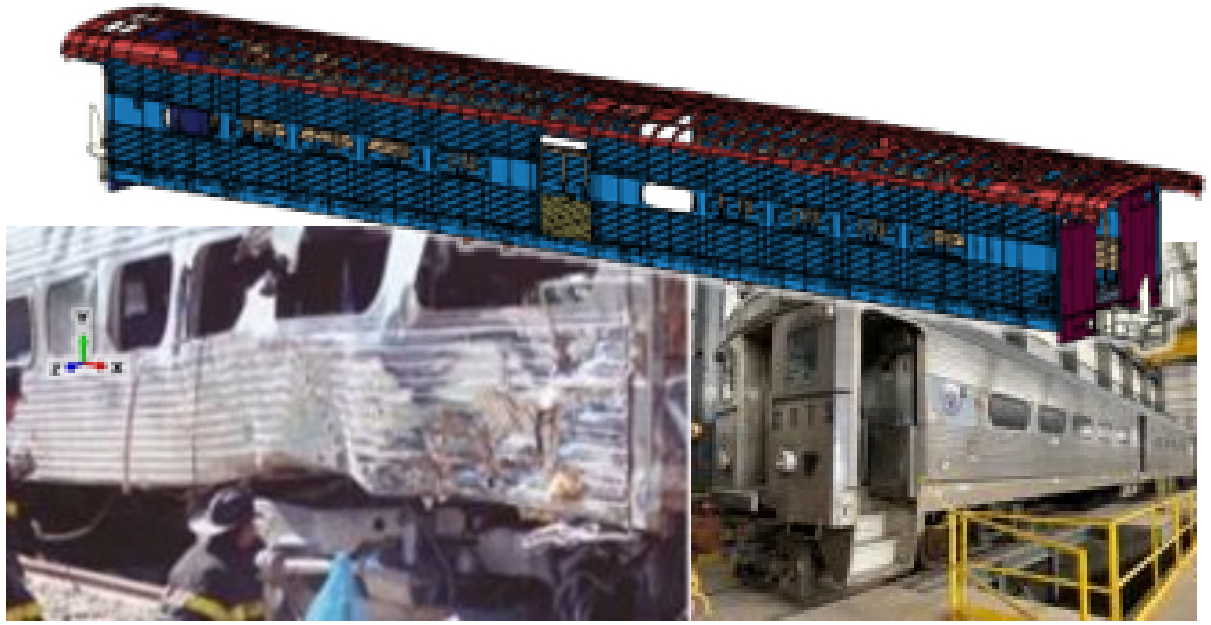
- FY24 Funding: $299,922.29
- Project Duration: July 2024 – July 2026 (SBIR Phase II)

FRA PROJECT MANAGER: Kevin B. Myles• (771) 233-3117 • kevin.myles@dot.gov

Passenger Railcar 800,000-lb End Strength Compression Test

PROJECT DESCRIPTION

- Evaluate an Arrow III passenger railcar using the 800,000-lb static end strength test found in 49 CFR Section 238.203.
- Use the results to validate a recently completed FEA model developed by the Volpe Center.
- Once validated, the FEA model and test results can be used to support future crashworthiness research, testing, and development.
- A validated model can then be used to inexpensively and quickly evaluate new designs, modifications, or improvements to rail vehicles without the need for full-scale and expensive testing.



RAILROAD IMPACT

- Data and information resulting from this research are used in the development of specifications, new designs, and regulations.
- Recent improvements to passenger car structural integrity based on this project reduce fatalities associated with a variety of common accident scenarios.

PROJECT PARTNERS

- ENSCO, Inc.
- Volpe National Transportation Systems Center

COST & SCHEDULE

- FY24 Funding: $814,450
- Project Duration: August 2025 – August 2026

FRA PROJECT MANAGER: Kevin B. Myles• (771) 233-3117 • kevin.myles@dot.gov

Advanced Onboard Energy Storage System Impact and Fire Testing Research

PROJECT DESCRIPTION

- Investigate the fire safety and crashworthiness of advanced onboard energy storage systems for rail propulsion under railroad loadings and scenarios.
- Determine facility and test requirements for a drop test of a battery-energy storage system (BESS).
- Design and construct a drop test facility at the FRA Transportation Technology Center consisting of a reinforced concrete pit and a gantry crane.
- Conduct a drop test on a BESS designed for rail use to simulate a fall from carbody height. Characterize the response of the BESS to resulting impact including electrical damage and potential resulting fire.

RAILROAD IMPACT

- Generate information and roadmap to define safety requirements for future BESS.
- Lay the foundation for safe rail operations with advanced BESS for propulsion.
- Enable expansion of advanced BESS use in rail transport in the U.S. and subsequently increase the efficiency of rail transport.

PROJECT PARTNERS

- ENSCO, Inc.
- Volpe National Transportation Systems Center
- Ambipar Response

COST & SCHEDULE

- FY24–25 Funding: $746,284
- Project Duration: September 2024 – February 2028

FRA PROJECT MANAGER: Melissa Shurland• (202) 493-1316 • melissa.shurland@dot.gov

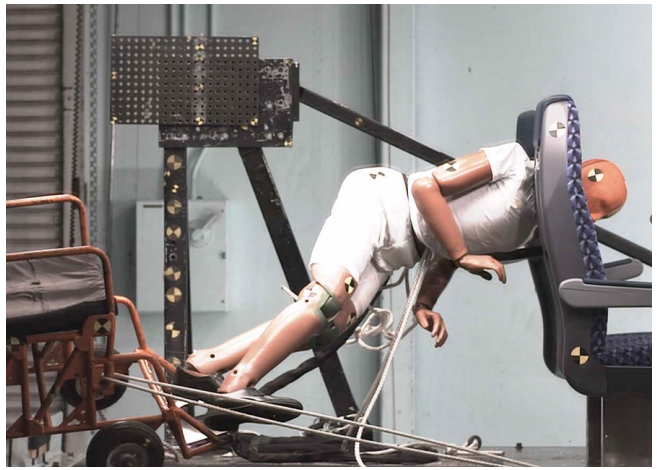
Wheelchair Safety and Accessibility Research

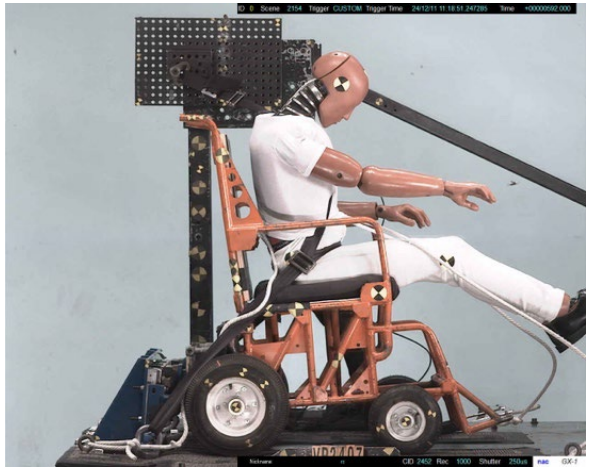
PROJECT DESCRIPTION

- Develop and evaluate strategies to improve safety associated with wheeled mobility devices (WhMDs) on passenger trains.
- Evaluate the influence of spatial recommendations to improve WhMD maneuverability on collision safety for train passengers seated in WhMDs, as well as nearby passengers.
- Evaluate improved accessible seating locations and crashworthiness of adjustable workstation tables in wheelchair seating areas.
- Review international operations and standards regarding wheelchair securement and passenger restraints on trains and buses.
- Tasks include:
  - Conduct second round of sled testing to evaluate additional configurations of secured and unsecured wheelchairs.
  - Evaluate adjustable workstation tables in wheelchair seating areas and influence on collision safety.
  - Conduct review of international rail and bus operations regarding wheelchair securement, occupant restraints, and related standards.

RAILROAD IMPACT

- As rail accessibility improves for wheelchair users, the exposure to collision safety risks will also increase. This research demonstrates the safety improvements with independently used securement and restraint systems.
- Promote voluntary implementation and adoption of wheelchair securement and passenger restraint systems to improve safety associated with wheelchairs on trains.





PROJECT PARTNERS

- Volpe National Transportation Systems Center
- University of Michigan Transportation Research Institute
- Q'Straint
- Kiel North America

COST & SCHEDULE

- FY25 Funding: $350,000
- Project Duration: May 2025 – May 2026

FRA PROJECT MANAGERS: Melissa Shurland • (202) 493-1316 • melissa.shurland@dot.gov

Engineering Support for Onboard Energy Storage Systems Testing

PROJECT DESCRIPTION

- Accident survey conducted to document “scenarios of concern” that should be considered in assessing the collision performance of emerging rail technology equipment such as hydrogen-fueled or battery-powered rail equipment
- Develop testing series for evaluating battery and hydrogen components in scenarios of concern, such as rollover, side impact, and fire.
- Develop computer modeling to prepare for a battery drop test.
- Perform rollover study for emerging rail technology locomotives to evaluate how changing the components on locomotive platforms may affect the likelihood of rollover.

RAILROAD IMPACT

- Identify scenarios of concern using the accident data collected by FRA to inform the industry of threats that should be considered in the intelligent design of new and retrofitted rail equipment including emerging rail technologies such as batteries and hydrogen.
- FRA works with industry to ensure the safety of innovative new technologies through engineering analysis, testing, and design reviews.
- Produce public crashworthiness and safety data that helps mitigate the propensity for injuries and fatalities associated with rail accidents and incidents involving emerging rail technology equipment.

Catenary pole intruded through coach car roof structure; intruded into occupant

PROJECT PARTNERS

- Volpe National Transportation Systems Center
- FRA Transportation Technology Center
- ENSCO, Inc.

COST & SCHEDULE

- FY25 Funding: $728,000
- Project Duration: May 2025 – May 2026

FRA PROJECT MANAGER: Melissa Shurland • (202) 493-1316 • melissa.shurland@dot.gov

Evaluation of Fire Suppression Systems for Li-ion Fires on Railcars

PROJECT DESCRIPTION

- Evaluate the efficacy of emerging fire suppression/extinguishing technologies for rail applications and the human factors impact on their effectiveness.
- Many rail passengers bring electric micromobility devices onboard, such as scooters, bikes, etc., that contain lithium-ion (Li-ion) batteries; extinguishing fires from these sources are problematic.
  - Passenger railroads are equipping railcars with fire extinguishing systems that proport to extinguish Li-ion battery fires.

RAILROAD IMPACT

- Passenger railroads will have data on the effectiveness of the technologies designed to extinguish Li-ion based fires.
- Industry standards and recommended practices can be developed based on research data.
- The human factors impact on effectiveness of emergency response will be highlighted.

PROJECT PARTNERS

- ENSCO, Inc.
- Volpe National Transportation Systems Center

COST & SCHEDULE

- FY25 Funding: $620,663
- Project Duration: September 2025 – September 2027

FRA PROJECT MANAGER: Melissa Shurland • (202) 493-1316 • melissa.shurland@dot.gov

Advanced Onboard Energy Storage Systems

PROJECT DESCRIPTION

- Provide technical review of emerging rail technology equipment proposed to FRA for use on the general railroad system.
- Contribution of technical advice through the presentation of analysis from tests and other engineering studies.
- Participation in working group meetings to support industry groups involved in standards development.

RISK ASSESSMENT MATRIX				
SEVERITY / PROBABILITY	Catastrophic (1)	Critical (2)	Marginal (3)	Negligible (4)
Frequent (A)	High	High	Serious	Medium
Probable (B)	High	High	Serious	Medium
Occasional (C)	High	Serious	Medium	Low
Remote (D)	Serious	Medium	Medium	
Improbable (E)	Medium	Medium	Medium	
Eliminated (F)	Eliminated			

RAILROAD IMPACT

- Ensure that emerging rail technology equipment poses no increased hazard when compared to existing diesel or electric (catenary or third rail) operations.
- Technical research results will support standards and regulatory development or improvement.
- Implementation of safer equipment design and practices.

PROJECT PARTNERS

- Volpe National Transportation Systems Center
- AAR, APTA, CSA Group, ANSI/ISO

COST & SCHEDULE

- FY25 Funding: $135,000
- Project Duration: May 2025-May 2026

FRA PROJECT MANAGER: Melissa Shurland• (202) 253-6539 • melissa.shurland@dot.gov

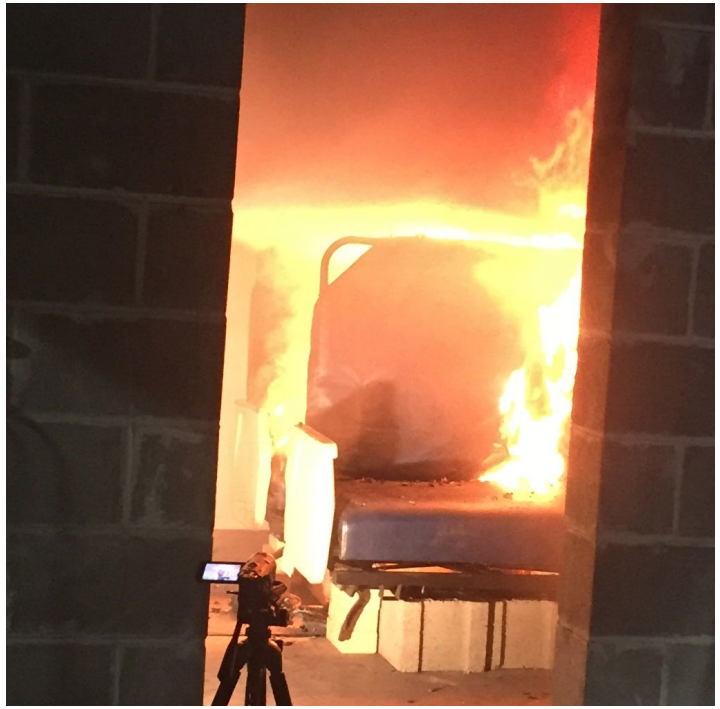
Material Fire Performance Longevity Research

PROJECT DESCRIPTION

- Investigate potential decay in the fire performance of passenger railcar materials over time. This will be accomplished by assessing the performance of older, in-use materials to evaluate compliance with reference standards and determine if materials have degraded in performance.
- Tests will be performed on used materials gathered from donated MBTA railcars.
- A test plan was developed detailing the tests to be performed on the available material samples, including seat cushions and upholstery.
- Fire performance test results will be analyzed and recommendations for further research or updates to standards will be developed.

RAILROAD IMPACT

- Inform industry on the expected degradation of material fire performance in passenger railcars over time.
- Gain understanding on the delta in fire performance between actual materials present in the passenger railcars and the original material composition.



PROJECT PARTNER

- Volpe National Transportation Systems Center

COST & SCHEDULE

- FY25 Funding: $244,489
- Project Duration: October 2023 – September 2026

FRA PROJECT MANAGER: Melissa Shurland • (202) 493-1316 • melissa.shurland@dot.gov

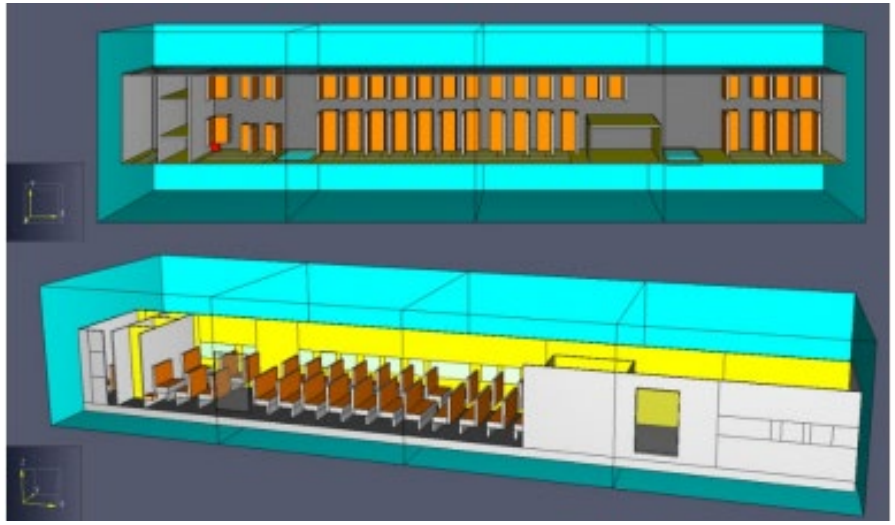
Technical Support for the Fire Safety Research Program

PROJECT DESCRIPTION

- Plan fire tests; conduct observations and oversight.
- Technical Report/deliverable review and feedback.
- Federal Representation in NFPA 130 Committee activities — as scheduled.
- Federal Representation in APTA Fire Safety Working Groups — as scheduled.
- Participate in meetings, testing, and report review for passenger train fire extinguisher research in coordination with FRA and its contractors — as needed.

RAILROAD IMPACT

- Advancement of fire safety through research.
- Modernized standardization and testing principles.
- Safety research on lithium-ion fire extinguishment.



PROJECT PARTNER

- Volpe National Transportation Systems Center

COST & SCHEDULE

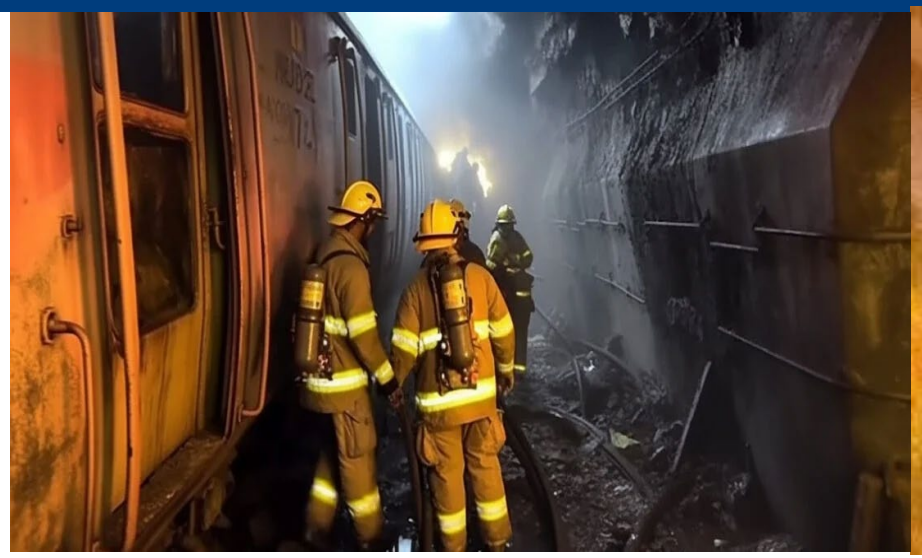
- FY25 Funding: $116,130
- Project Duration: August 2024 – August 2026

FRA PROJECT MANAGER: Melissa Shurland • (202) 493-1316 • melissa.shurland@dot.gov

Emergency Preparedness Research Program

PROJECT DESCRIPTION

- Provide engineering support the FRA Office of Railroad Safety in emergency preparedness activities such as research and analysis into emergency preparedness plans, passenger train emergency simulations, and associated debriefings and critiques as codified in Title 49 CFR Part 239 and relevant sections of Part 238.
- Participate in ongoing discussions and collaborations with FRA staff and other Federal stakeholders, and support stakeholder outreach on efforts to improve outcomes for those involved in passenger train emergencies.



RAILROAD IMPACT

- Reduce casualties by requiring that passenger rail system operators provide a basic level of emergency preparedness and response capability through the development of emergency plans and procedures (Title 49 CFR Part 239) which include communication, training, qualification, staffing, equipment, and other requirements.

PROJECT PARTNER

- Volpe National Transportation Systems Center

COST & SCHEDULE

- FY25 Funding: $50,000
- Project Duration: September 2025 – September 2026

FRA PROJECT MANAGER: Melissa Shurland • (202) 493-1316 • melissa.shurland@dot.gov

Hydrogen Safety Research for Rail Applications

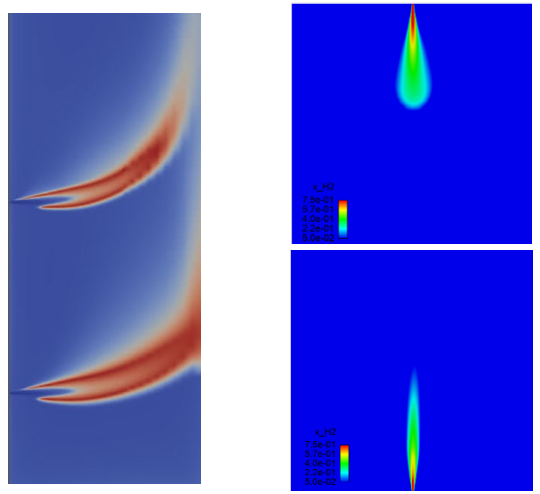
PROJECT DESCRIPTION

- Unknown safety risks regarding the use of hydrogen in the rail environment should be identified and understood.
- Sandia will use the latest available knowledge and technology, such as leak modeling using HyRAM+, computational fluid dynamics computer simulations, risk assessments, literature searches, small scale laboratory testing, etc., to inform decision-makers and rail designers.
- Research will encompass multiple tasks that will examine crashworthiness, fire safety, emergency response, human interaction, maintenance facility hazards, hydrogen trains in tunnels, and materials compatibility with hydrogen.

RAILROAD IMPACT

- Fuels such as hydrogen can potentially provide alternative, domestic propulsion for rail transportation, enabling freight/delivery resilience.
- This research can identify potential safety issues regarding the use of gaseous or liquid hydrogen and aid in developing safety recommendations.
- Understanding and communicating relevant domestic and global standards, lessons learned, best practices for using hydrogen fuel, and requirements for its use in the railroad environment can help reduce burdens on industry and investors.

Sandia National Laboratories



PROJECT PARTNER

- Sandia National Laboratories

COST & SCHEDULE

- FY25 Funding: $459,018
- Project Duration: September 2020 – September 2026

FRA PROJECT MANAGER: Melissa Shurland • (202) 493-1316 • melissa.shurland@dot.gov

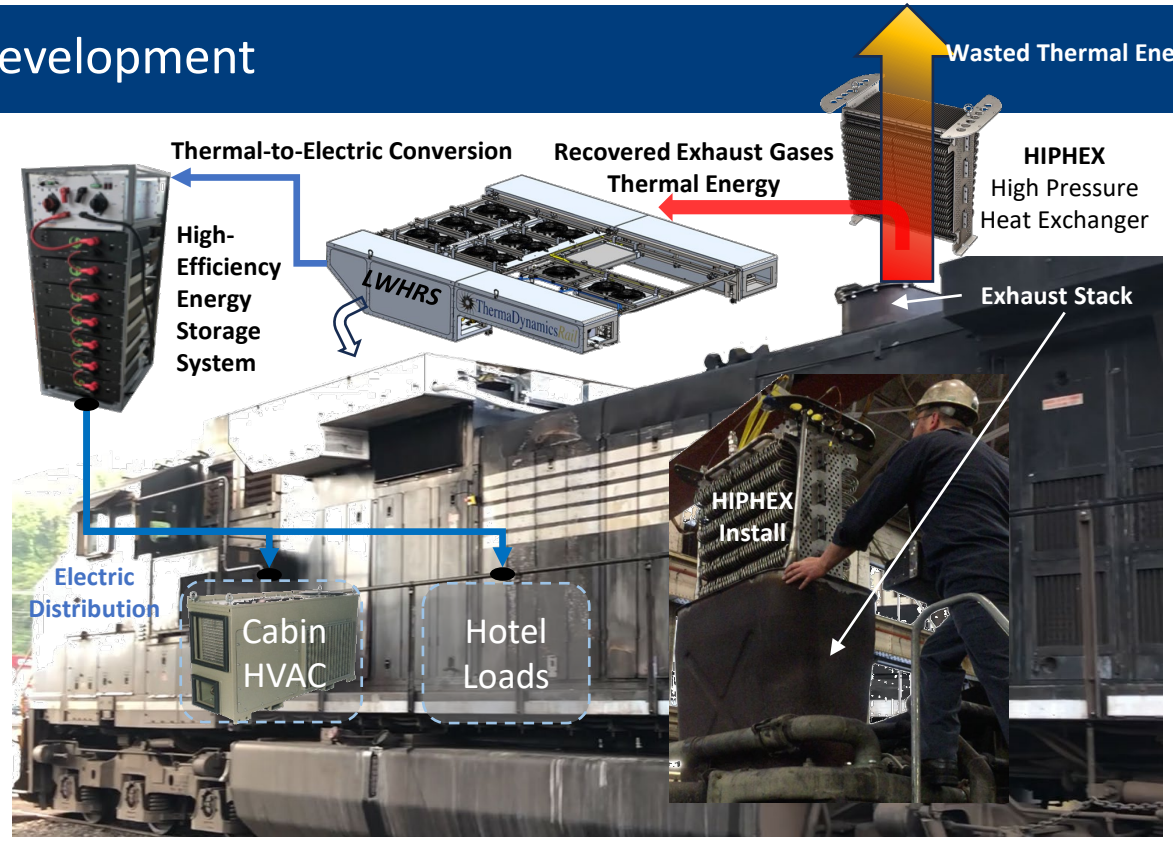
Locomotive-Waste Heat Recovery System (L-WHRS) Development

PROJECT DESCRIPTION

- Validate technical, safety, and reliability performance of the L-WHRS by quantifying their ability to generate electric power from locomotive exhaust gases in different operating conditions.
  - Different notch settings generate variable mass and temperature of the exhaust gases, leading to route-/operation-dependent fuel savings.
- Universalize the L-WHRS components for Wabtec (GE-type) locomotives and identify Wabtec L-WHRS components that can support retrofitting of Progressive Rail (EMD-type) locomotives with minimum scaling or modification to the L-WHRS components.
- Verify advanced manufacturing approaches for design optimization of the heat exchanger and turbo-generator components to lower operational and maintenance costs.

RAILROAD IMPACT

- L-WHRSs represent a "free," independent source of pollutant-free electric power that can augment locomotive electric supply availability; provides additional power and improved efficiency for railroad equipment.
- Retrofitting locomotives with L-WHRS results in reduced fuel consumption by tapping otherwise wasted locomotive thermal energy and converting it to electricity distributed to supply hotel loads or charge batteries.
- Non-invasive retrofitting of current fleet provides low-cost opportunity to improve efficiency of aging locomotives and reduces operational disruption due to malfunctioning or failed OEM lead-acid batteries.
- Available power can reduce locomotive idling.

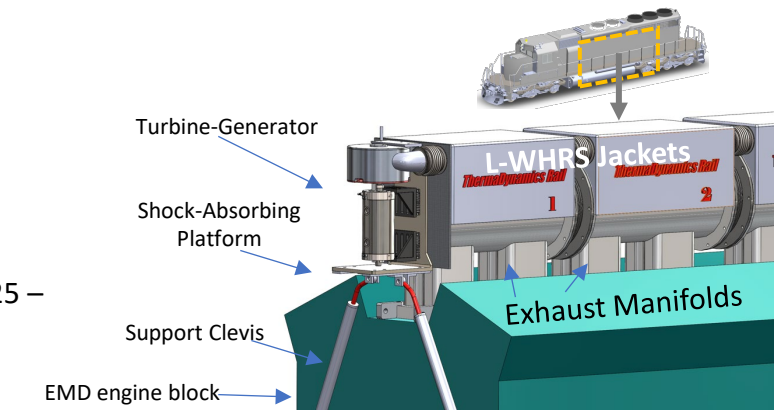


PROJECT PARTNERS

- ThermaDynamics Rail LLC
- ASLRRA
- Class II and III RRs

COST & SCHEDULE

- FY23 Funding: $500,000
- Project Duration: November 2025 – September 2027



U.S. Department of Transportation
Federal Railroad Administration

FRA PROJECT MANAGER: Melissa Shurland • (202) 493-1316 • melissa.shurland@dot.gov

Interior Occupant Protection Research

PROJECT DESCRIPTION

- Identify and evaluate interior safety improvements in passenger railcars to reduce injuries and fatalities in accidents.
  - Identify interior hazards to passengers and crew during accidents.
  - Develop strategies to mitigate interior safety hazards.
  - Test strategies and evaluate the safety improvement compared to the baseline.
- Tasks include:
  - Finalize research seat test results using small, medium, and large crash test dummies, aka ATDs, to evaluate collision safety for a larger range of the population.
  - Draft technical paper describing model validation of THOR-50M ATD abdomen impact tests. An ATD is used to assess workstation table crashworthiness.
  - Conduct literature review of seatbelt usage in international rail and bus operations, and related standards.

RAILROAD IMPACT

- The results of this research are being used to identify improvements to industry standards that influence interior passive safety.
- These research results will also be presented to the APTA Construction and Structural Working Group.

PROJECT PARTNERS

- Volpe National Transportation Systems Center
- Calspan
- Seat manufacturers

COST & SCHEDULE

- FY25 Funding: $245,000
- Project Duration: May 2025 – May 2026

FRA PROJECT MANAGERS: John Manutes • (202) 744-1030 • john.manutes@dot.gov
Melissa Shurland • (202) 493-1316 • melissa.shurland@dot.gov

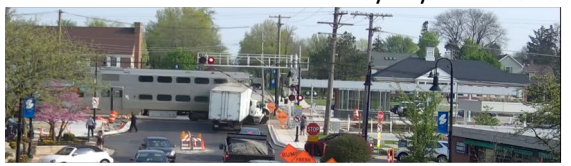
Accident Field Investigations

PROJECT DESCRIPTION

- Conduct accident investigations of major accident/derailment incidents with a team of Federal investigators to evaluate the crashworthiness performance of existing railroad equipment.
- Reconstruct the sequences of events that lead to injuries and fatalities.
- Collect the survival factors data to identify the causal mechanism for injuries and fatalities in railroad accidents, i.e., equipment damage, interior damage, interviews of passengers and crew.
- Document the reconstruction of the sequence of events that led to the injuries and fatalities.
- Prepare a Technical Report from the technical data collected in field investigations.

9/17/21 - Joplin, MT

5/11/22 - Clarendon, IL



6/27/22 - Mendon, MO

RAILROAD IMPACT

- Learn from the most severe accident/derailment scenarios what trends are causing injuries and fatalities.
- Findings serve to assess the current performance of rail equipment, interiors, emergency egress, fuel tank integrity, and other safety features.
- Field investigations help to inform the FRA's research plans for improving crashworthiness
- Evaluate effectiveness of current regulations by assessing performance of equipment structures and interior configurations in protecting occupants during accidents.
- Assess the effectiveness of current regulations for emergency preparedness features, glazing performance, and fuel tank integrity.

PROJECT PARTNERS

- Volpe National Transportation Systems Center
- FRA Office of Railroad Safety

COST & SCHEDULE

- FY25 Funding: $45,000
- Project Duration: May 2025 – May 2026

U.S. Department of Transportation
Federal Railroad Administration

FRA PROJECT MANAGER: John Manutes • (202) 744-1030 • john.manutes@dot.gov
Melissa Shurland • (202) 493-1316 • melissa.shurland@dot.gov

Locomotive Structural Crashworthiness Research

PROJECT DESCRIPTION

- Demonstrated effectiveness of crashworthy components in preventing override in impact test collisions involving locomotives.
- Evaluated performance of the combination of a push-back coupler and deformable anti-climber under full-scale dynamic impact scenarios.
- Designed combined crashworthy components as a Crash Energy Management (CEM) system, which can be retrofit to existing locomotives.
- Developed recommendation document for locomotive crashworthiness standards.
- Conducted survey of recent locomotive override rail incidents to identify the modes of deformation that may lead to override.
- Performed override study to demonstrate effectiveness of CEM in reducing propensity for override between two consists relative to an identical collision involving a conventional locomotive.
- Determined extent to which impact speed and vertical offset affect the propensity for override.

RAILROAD IMPACT

- Developed and demonstrated the effectiveness of the locomotive CEM system in improving locomotive crashworthiness by inhibiting override and lateral buckling and by absorbing collision energy.
- Demonstrated that CEM features can be retrofit onto existing locomotives and are repairable, serviceable, and compatible with a range of impacting equipment.
- Mitigating the propensity for override reduces fatalities and serious injuries in rail accidents.
- Test program results, validated computer models, override study, and rail incident survey inform the development of a recommendation document for locomotive crashworthiness standards.

NBC News, Accessed February 12, 2018

PROJECT PARTNERS

- Volpe National Transportation Systems Center
- FRA Transportation Technology Center
- ENSCO, Inc.

COST & SCHEDULE

- FY25 Funding: $180,000
- Project Duration: May 2025 – May 2026

U.S. Department of Transportation
Federal Railroad Administration

FRA PROJECT MANAGERS: Melissa Shurland • (202) 493-1316 • melissa.shurland@dot.gov
John Manutes • (202) 744-1030 • john.manutes@dot.gov

Forensics Investigation Trainings

PROJECT DESCRIPTION

- Develop curricula for a series of FRA's Forensics Training courses.
- Teach Forensics Training courses to FRA Regional inspectors in preparation for assisting with forensics investigations.
- Prepare new forensics inspectors with examples from accidents and simulated field exercises.

RAILROAD IMPACT

- Increase the accident data currently gathered by FRA inspectors to include forensics data, and prepare public reports of key findings.

PROJECT PARTNERS

- Volpe National Transportation Systems Center
- FRA Office of Railroad Safety
- FRA Transportation Technology Center
- National Transportation Safety Board

COST & SCHEDULE

- FY25 Funding: $40,000
- Project Duration: May 2025 – May 2026

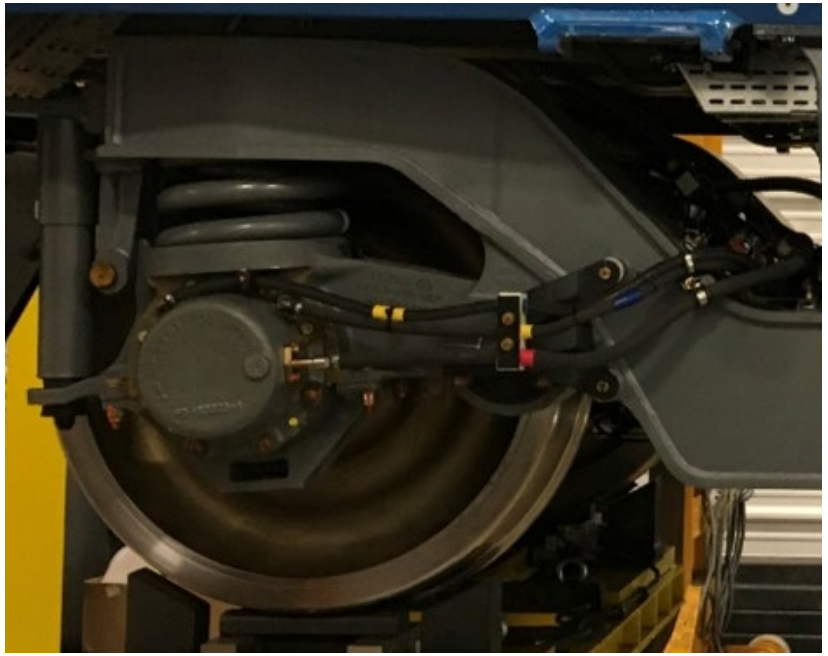
U.S. Department of Transportation
Federal Railroad Administration

FRA PROJECT MANAGERS: John Manutes • (202) 744-1030 • john.manutes@dot.gov
Melissa Shurland • (202) 493-1316 • melissa.shurland@dot.gov

Vehicle-Track Interaction — Support for Office of Railroad Safety and Rail Industry

PROJECT DESCRIPTION

- Provide technical expertise and coordination to apply regulations and industry standards for safe rail vehicle-track interaction (VTI). This includes analyses and simulations of vehicle responses to track geometry irregularities, a review of vehicle qualification and service data, and incorporation of international best practices.
- Support the development of regulations and industry standards to promote the safe interaction of rail vehicles with rail tracks.
- Conduct a technical review of rail equipment from the standpoint of derailment safety and performance evaluation based on the design and condition of the suspension and operating conditions.
- Offer technical support in evaluating and methods for measuring and characterizing the condition of wheel profiles.
- Offer technical support for safe VTI.



RAILROAD IMPACT

- Improved safety and reliability of rail operations through effective standards for VTI.
- Improved wheel-rail measurement practices with data-driven insights for rail vehicle procurements and operations.
- Reduced likelihood of derailment for passenger trains.
- Improves safety and ride quality, reduces derailment risk, and supports safer vehicle procurements and deployments.

PROJECT PARTNER

- Volpe National Transportation Systems Center

COST & SCHEDULE

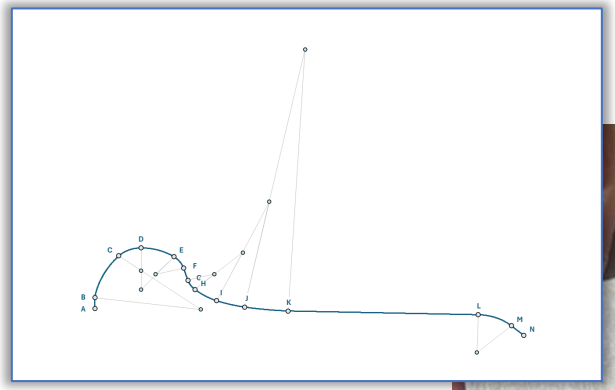
- FY25 Funding: $195,000
- Project Duration: May 2025 – May 2026

FRA PROJECT MANAGER: John Manutes • (202) 744-1030 • john.manutes@dot.gov

Vehicle-Track Interaction – Technical Support for Wheel Profile Measurement Technology

PROJECT DESCRIPTION

- Evaluation and support for next generation of wheel measurement tools.
- Support FRA's Phase II SBIR contractors developing a portable wheel geometry measurement device (reviews, meetings, technical analyses, and guidance).
- Effectiveness assessment of modern wheel profile tools.
- Procure and evaluate handheld wheel profile device(s), compare against MiniProf/wayside detectors and accident data, and assess conformance with APTA standards.



RAILROAD IMPACT

- Validates new measurement technology for maintenance adoption, enabling improved preventive maintenance and defect mitigation.
- Faster, more accurate wheel inspection in shop/field, which will lead to earlier defect detection, reduced downtime, and lower derailment risk.

PROJECT PARTNERS

- Volpe National Transportation Systems Center
- Amtrak

COST & SCHEDULE

- FY25 Funding: $115,000
- Project Duration: May 2025 – May 2026

FRA PROJECT MANAGER: John Manutes • (202) 744-1030 • john.manutes@dot.gov

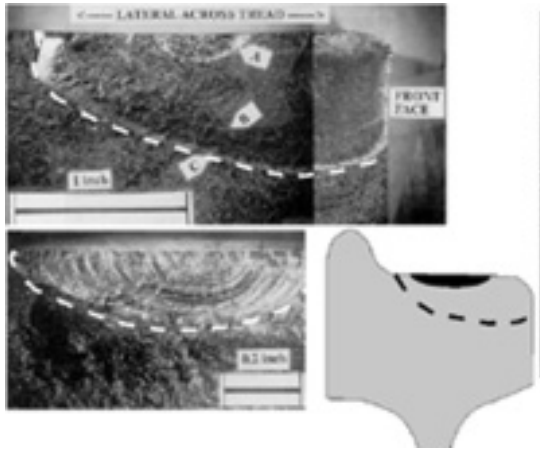
Equipment and Component Structural Integrity Research – Technical Support

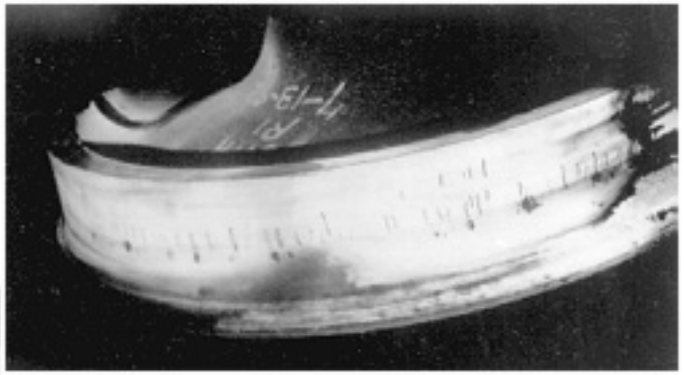
PROJECT DESCRIPTION

- Provide analytical capabilities to evaluate the performance of critical components under dynamic wear or severe/unusual loading conditions.
- Evaluate and inform deployment of wayside detection technologies to detect latent defects in critical passenger rail components, enabling safer operations, earlier maintenance, and reduced risk of in-service failures.
- Technical support and stakeholder working group assess vertical split rim wheel failures, including identifying data collection improvements and mitigation strategies to reduce risk and enhance rail safety.

RAILROAD IMPACT

- Enhanced safety through early detection of defects in critical components (e.g., wheels, springs, brakes, etc.), enabling proactive maintenance before failures occur in service.
- Informs improved inspection/maintenance strategies and design changes that reduce failures, lower operating risk, and extend service life.
- Working group engagement and FE analyses foster industry-wide understanding of wheel and component failure mechanisms, aiding standardization and best practices.





PROJECT PARTNER

- Volpe National Transportation Systems Center

COST & SCHEDULE

- FY25 Funding: $120,000
- Project Duration: May 2025 – May 2026

FRA PROJECT MANAGER: John Manutes • (202) 744-1030 • john.manutes@dot.gov

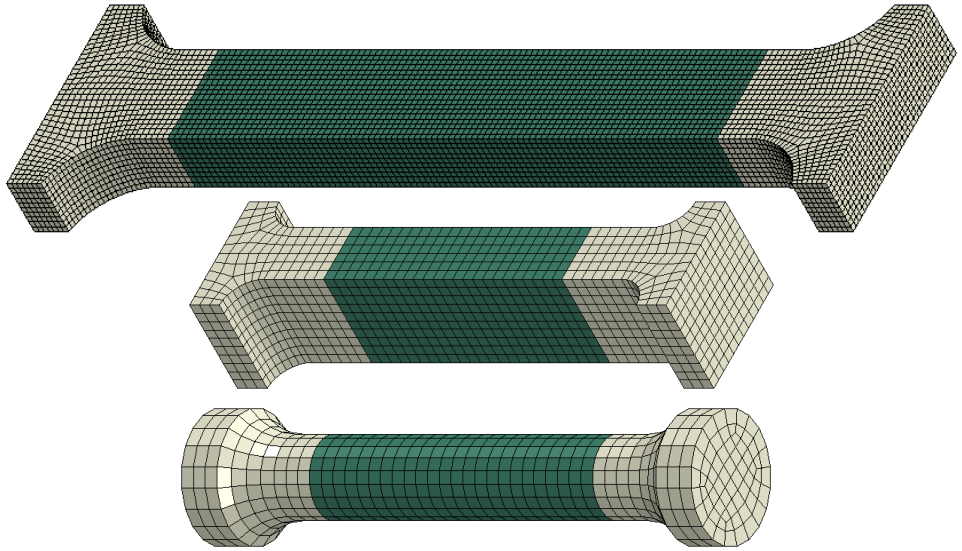
Tank Car Materials — Construction and Components

PROJECT DESCRIPTION

- Use simulation and modeling to assess the puncture resistance of alternative construction alloys and hypothetical material for rail tank cars.
- Develop a testing and sampling plan to evaluate the fire performance of approved, off-the-shelf thermal protection systems through controlled failure testing.
- Develop a testing and sampling plan for the performance characterization of service-used tank car components and systems.

RAILROAD IMPACT

- Evaluating alternate construction alloys can provide a “best case” estimate of theoretical puncture resistance attainable by typical tank car designs.
- Determining performance limits of existing thermal protection systems is a first step toward improving thermal performance in post-incident fires.
- Understanding the performance of service-used tank car components can help identify changes in reliability over time.



PROJECT PARTNERS

- Volpe National Transportation Systems Center
- Pipeline and Hazardous Materials Safety Administration

COST & SCHEDULE

- FY25 Funding: $250,000
- Project Duration: May 2025 – May 2026

FRA PROJECT MANAGER: Brian Won• (202) 893-6468 • brian.won@dot.gov

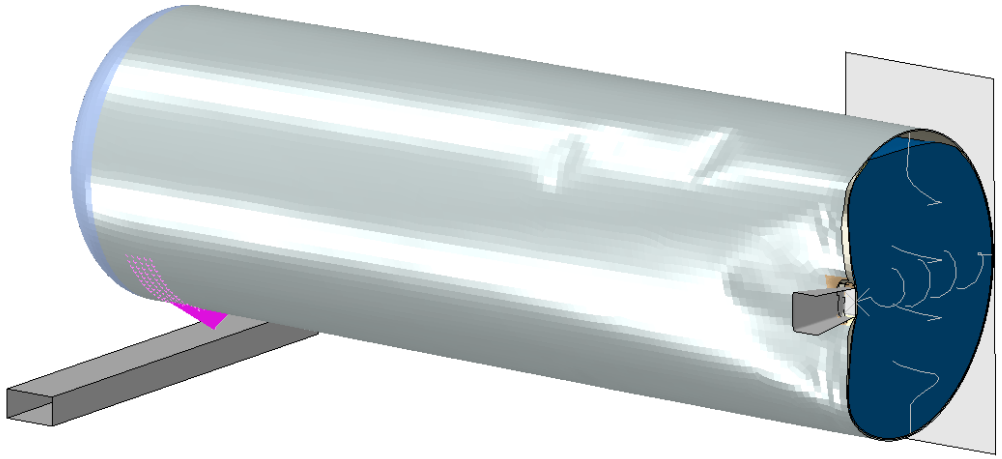
Tank Car Impact and Puncture Behaviors

PROJECT DESCRIPTION

- Evaluation of concepts to protect rail tank cars against punctures and penetrations from impacting objects in the event of a collision or derailment, reducing likelihood of spilling the commodity inside the tank car.
- Modeling and simulation in support of full-scale side impact tests.
- Modeling and simulation to examine alternative head protection concepts and small-scale test concepts.
- Analyze the effectiveness of alternative approaches to “breakaway” tank car stub sill attachment design.
- Evaluate effectiveness of protective housings and/or “breakaway” service equipment at preventing lading loss from DOT-113 tank cars.

RAILROAD IMPACT

- Develop methods to evaluate and compare the crashworthiness and structural integrity of different tank car design features (e.g., different materials and material thicknesses).
- Improving puncture resistance of tank cars carrying hazardous materials improves on existing safety and reduces consequences from impacts or derailments.



PROJECT PARTNERS

- Volpe National Transportation Systems Center
- Pipeline and Hazardous Materials Safety Administration
- ENSCO, Inc.
- National Institute of Standards and Technology

COST & SCHEDULE

- FY25 Funding: $425,000
- Project Duration: May 2025 – May 2026

FRA PROJECT MANAGER: Brian Won• (202) 893-6468 • brian.won@dot.gov

Tank Car Safety — Industry Interaction and Support for Office of Railroad Safety

PROJECT DESCRIPTION

- Participate in Government and industry activities related to railroad tank car safety and security, such as AAR Tank Car Committee meetings.
- Provide engineering support for tank car safety activities such as rulemakings, waiver request evaluations, and accident investigations.
- Evaluate research proposals and help monitor ongoing work, such as the Broad Agency Announcement and Small Business Innovative Research programs.

RAILROAD IMPACT

- Ensuring stakeholders have access to latest information developed from research projects.
- Supporting the FRA Office of Railroad Safety in its incident investigations and responses to NTSB Safety Recommendations.
- Ensuring future project work is timely and driven by emerging needs.

PROJECT PARTNERS

- Volpe National Transportation Systems Center
- Pipeline and Hazardous Materials Safety Administration

COST & SCHEDULE

- FY25 Funding: $200,000
- Project Duration: May 2025 – May 2026

U.S. Department of Transportation
Federal Railroad Administration

FRA PROJECT MANAGER: Brian Won• (202) 893-6468 • brian.won@dot.gov

Full-Scale Tank Car Crash Testing

PROJECT DESCRIPTION

- Conduct full-scale tank car impact tests and corresponding data analysis to evaluate the crashworthiness performance of tank cars used in the transportation of hazardous materials, including the ones transporting Toxic by Inhalation Materials (TIH), and cryogenic liquids.
- Current scope of work includes three tests:
  - Acquire and inspect tank car for testing.
  - Develop the test plans and prepare the tank car for testing.
  - Install instrumentation.
  - Test conduct.
  - Analyze data.
  - Conduct post-test activities (material testing, inspections and measurements, other).

RAILROAD IMPACT

- Increase knowledge of the tank car performance in derailment load condition.
- Provide experimental data for tank car manufacturers for development and design improvements.
- Provide data for the verification and refinement of computational models.
- Expand talent pool of rail professionals.
- Provide the technical information to inform regulatory activities.

PROJECT PARTNERS

- ENSCO, Inc.
- Volpe National Transportation Systems Center

COST & SCHEDULE

- FY24 Funding: $1,059,531
- Project Duration: September 2022 – March 2026

FRA PROJECT MANAGER: Brian Won• (202) 893-6468 • brian.won@dot.gov

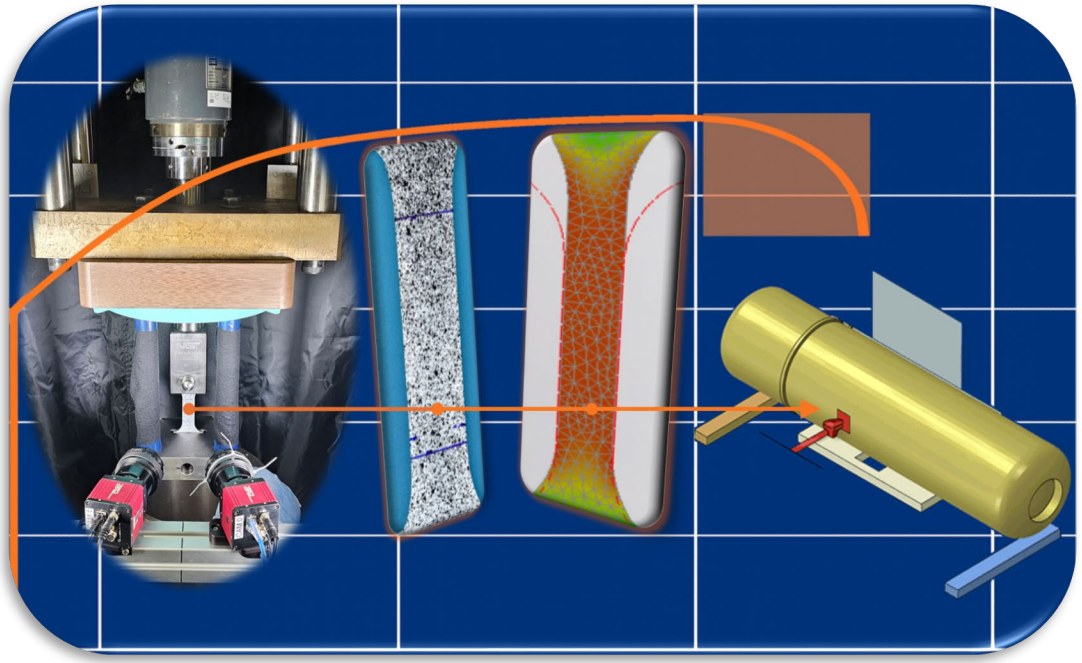
Cryogenic Mechanical Properties of DOT-113 Tank Car

PROJECT DESCRIPTION

- Determine inner tank material properties of the DOT-113 tank car as a function of temperature, strain-rate, and tri-axiality.
- Develop a comprehensive matrix of datasets to calibrate the material models used in FE modelling of the full-scale impact/puncture conditions.
- Develop a scaled bi-axial test to validate the material models as a function of temperature and strain-rate.
- Perform instrumented Charpy impact tests to validate impact toughness.
- Develop constitutive equations for material properties as a function of temperature, strain-rate, triaxiality, and chemistry/microstructure.

RAILROAD IMPACT

- Directly measuring the true stress-plastic equivalent strain data after the onset of necking would significantly improve the reliability of the DOT-113 tank car impact model.
- This model will be used to determine the puncture resistance of a DOT-113 tank car under service conditions; improving model reliability will strengthen the technical basis for possible future rulemakings on the transportation of cryogenic materials by rail.



PROJECT PARTNERS

- National Institute of Standards and Technology – Boulder
- Volpe National Transportation Systems Center

COST & SCHEDULE

- FY25 Funding: $578,350
- Project Duration: September 2023 – September 2026

FRA PROJECT MANAGER: Brian Won• (202) 893-6468 • brian.won@dot.gov

Acquisition, Transportation and Maintenance of Failed/Damaged Rail Tank Cars and/or Components

PROJECT DESCRIPTION

- Acquisition, transportation, and storage of the tank cars and tank car components.
- Evaluation and documentation of the damage to railroad tank cars involved in accidents.
- Maintenance of the storage location.
- Material testing support.

RAILROAD IMPACT

- Provides real examples for training FRA Inspectors in proper techniques and procedures in performing Damage Assessment and Casual Factor Evaluations.
- Supports rail accidents/incidents investigation and analysis.
- Provides a source of test specimens for future research.

PROJECT PARTNERS

- ENSCO, Inc.
- Railroads (tank car and specimen donations)

COST & SCHEDULE

- FY24 Funding: $329,783
- Project Duration: July 2024 – July 2026

FRA PROJECT MANAGER: Brian Won• (202) 893-6468 • brian.won@dot.gov

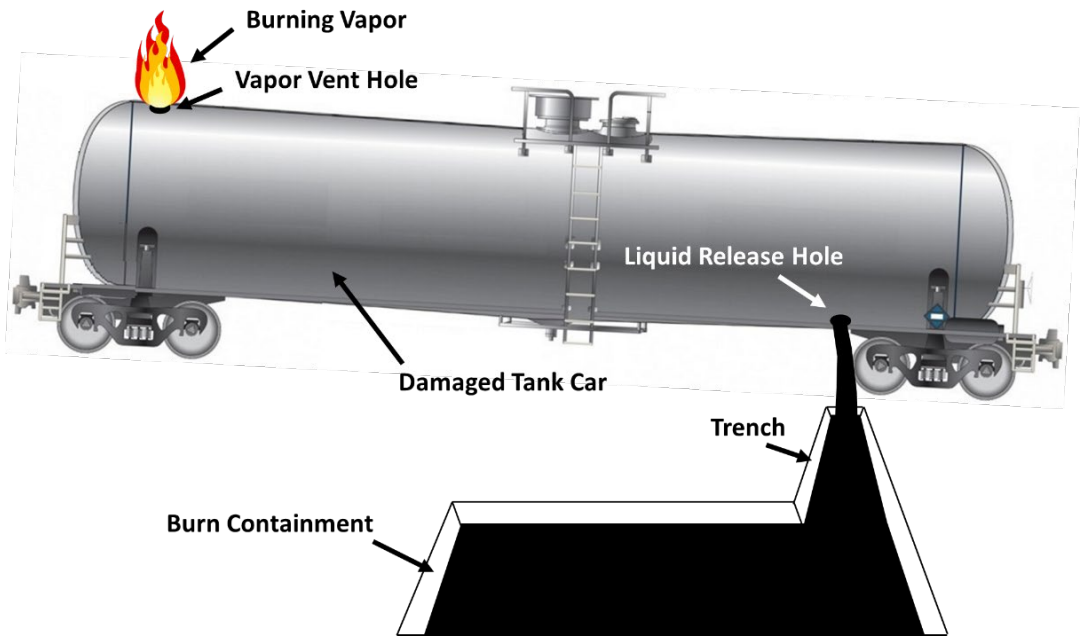
Tank Car Vent and Burn Process Study and Report Update

PROJECT DESCRIPTION

- Update the Tank Car Vent and Burn (V&B) Process and Procedure report to better inform incident commanders; enhance rail hazardous material accident response and effective post-accident hazardous material release mitigation. Tasks include:
  - Assemble Industry Advisory Panel.
  - Conduct V&B procedure review meetings.
  - Update Tank Car Vent and Burn Process and Procedure report.

RAILROAD IMPACT

- V&B is an effective process used by railroad emergency response personnel to mitigate serious railroad emergencies involving specific types of hazardous material shipments in tank cars. This process is a method of last resort when an uncontrolled release of large amounts of hazardous material is imminent due to tank failure.
- The updated report aims to provide clearer instructions and more comprehensive guidance for vent-and-burn scenarios, helping incident commanders make safer, better-informed decisions during hazmat rail incidents.



PROJECT PARTNERS

- ENSCO, Inc.
- ARTC – Ambipar

COST & SCHEDULE

- FY25 Funding: $243,538
- Project Duration: February 2025– July 2026

FRA PROJECT MANAGER: Brian Won• (202) 893-6468 • brian.won@dot.gov

Tank Car Train Handling and Combination Track Perturbation Evaluation

PROJECT DESCRIPTION

- Evaluate the impact of train handing and combination track perturbations, and compare flat coupling test with previous impact testing.
- FRA research shows high-magnitude coupling forces that occur in yard operations have the potential to exceed yield limits of mild steel.
- FRA, ENSCO, Union Tank Car, and Amsted Rail completed a comprehensive test program to characterize tank carload environments at Amsted Rail's test facility in Camp Hill, PA.
    - FRA, ENSCO, Union Tank Car, and a Class I railroad recently completed autonomous testing over 10 months and 14,000 miles to characterize the typical load environment for revenue service.
- This task is focused on comprehensive analysis of the collected impact test data to better understand the limiting conditions for coupling speed and impacting mass.

RAILROAD IMPACT

- Create better understanding of the operational environment and root cause of fractures on tank cars.
- Develop speed and mass combination curves to mitigate tank car stub sill failures.
- Conduct over-the-road brake testing to target a variety of issues faced by the industry.

Stub Sill Crack

Autonomous Testing

Impact Testing

Instrumented Wheelsets

PROJECT PARTNERS

- ENSCO, Inc.
- Union Tank Car Co.
- Amsted Rail Company, Inc.
- Class I railroads

COST & SCHEDULE

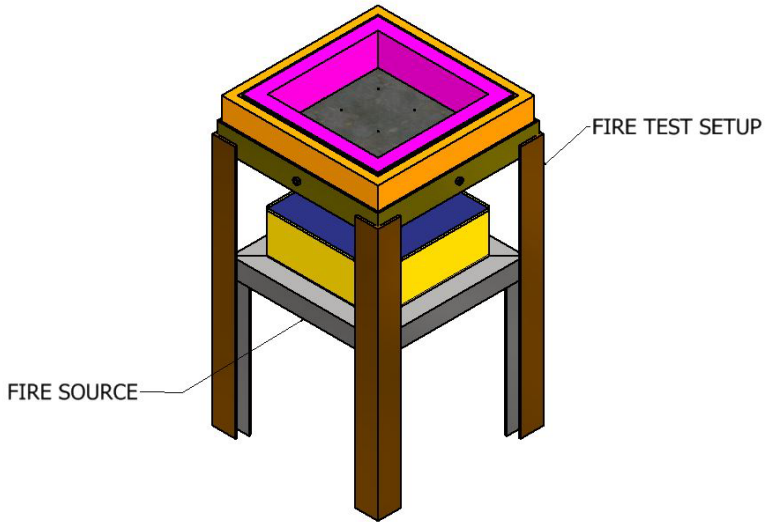
- FY23–24 Funding: $956,432
- Project Duration: August 2023 – October 2026

FRA PROJECT MANAGER: Brian Won• (202) 893-6468 • brian.won@dot.gov

Pool Fire Tests of DOT-112 Tank Car Thermal Protection System

PROJECT DESCRIPTION

- Evaluate insulation performance as specified in Appendix B, paragraph 2 in Title 49 CFR Part 179, Simulated Pool Fire Test to determine whether the thermal protection blanket conformed to the requirements of the regulations.
- Investigate a recent derailment of a freight train which included six tank cars carrying propane, carried in DOT-112 cars.
- In corporation with National Transportation Safety Board, conduct performance testing on the thermal protection system of cars involved in the incident, which consists of FyreWrap blankets overlaid by an 11-gauge steel jacket.



RAILROAD IMPACT

- Improved understanding of the performance of thermal protection systems.
- Reduced risk of derailment consequences, especially with flammable liquids and fire conditions.

PROJECT PARTNERS

- Sharma & Associates, Inc.
- Underwriters Laboratories

COST & SCHEDULE

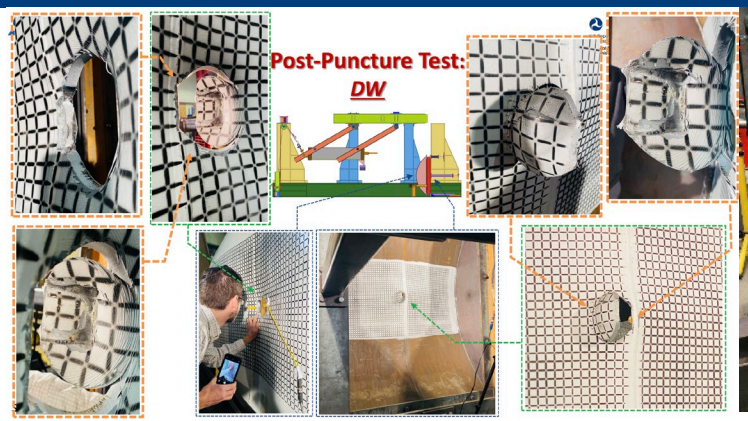
- FY25 Funding: $124,620
- Project Duration: June 2025 – June 2026

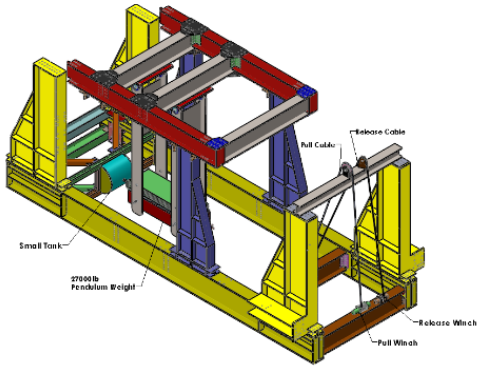
FRA PROJECT MANAGER: Brian Won• (202) 893-6468 • brian.won@dot.gov

Modeling and Testing Using a Pendulum Impactor

PROJECT DESCRIPTION

- Develop and prototype a repeatable test setup that can used for impact and puncture testing of small-scale tanks, full-scale tank sections, and weld samples.
- Conduct additional puncture testing using the pendulum impact machine and related simulations to better understand puncture performance, including weld performance, cold weather performance, and scaling effects on different tank cars.
- The setup uses a pendulum with a 4-bar linkage, a heavy weight, and a defined impactor to conduct puncture testing of tanks.
- The system was used to test and evaluate weld performance on several full-scale tank sections from an LNG tank car.





RAILROAD IMPACT

- Better understanding of puncture behavior on tanks, leading to improved and safer tank car designs.
- Improved validation of design methods used by industry.

PROJECT PARTNERS

- Sharma & Associates, Inc.
- Volpe National Transportation Systems Center

COST & SCHEDULE

- FY24 Funding: $498,000
- Project Duration: September 2024 – September 2026

FRA PROJECT MANAGER: Brian Won• (202) 893-6468 • brian.won@dot.gov

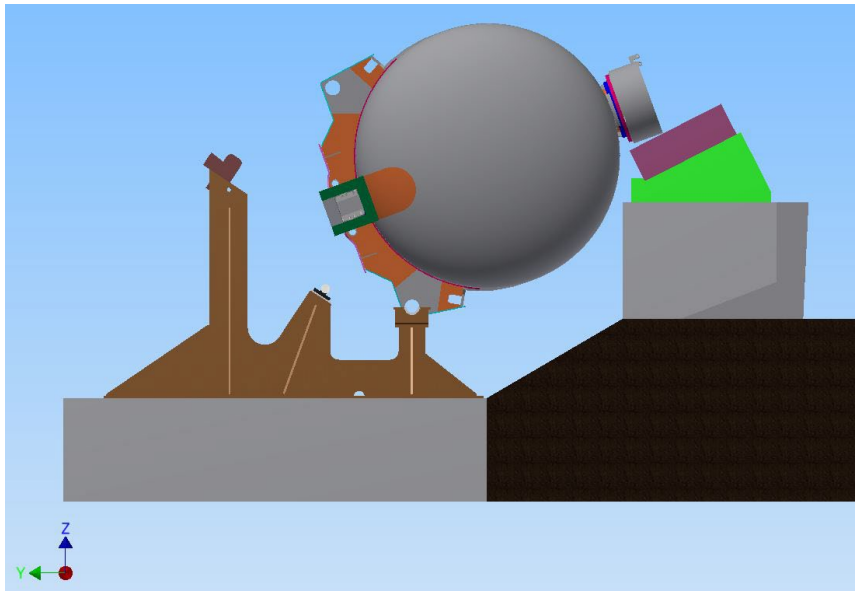
Improving Safety of Tank Car Fittings in Hazmat Service

PROJECT DESCRIPTION

- Evaluate the performance of top fittings protection used on current design tank cars, particularly those used in unit trains carrying flammable materials, under rollover conditions.
  - Conducted through a series of analytical simulations and full-scale rollover tests.
- Designs considered include:
  - CPC-1232 style designs
  - Innovative, industry-proposed options
- Calibrate analytical models to test results.
- Develop criteria and protocols for future industry research.
- Current focus is on setting up the test fixture at the Transportation Technology Center and conducting the next set of tests.

RAILROAD IMPACT

- Improve overall safety of tank car operations by mitigating the release of hazardous material in tank car rollover derailments.
- Help develop performance information that can be used by the industry for standards development.
- Develop recommendations for future design and testing of fittings.



PROJECT PARTNERS

- Sharma & Associates, Inc.
- ENSCO, Inc.
- Tank car manufacturers
- Class I railroads (CSX, UP, BNF, CP, NS)

COST & SCHEDULE

- FY24 Funding: $412,300
- Project Duration: August 2024 – August 2026

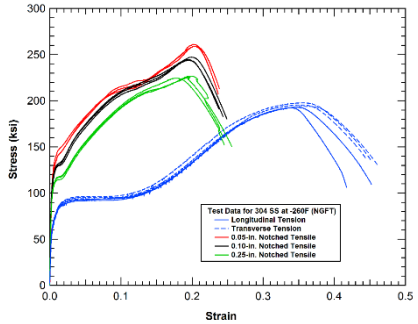
FRA PROJECT MANAGER: Brian Won• (202) 893-6468 • brian.won@dot.gov

Rail Crash Safety of Liquid Hydrogen (LH_2) Fuel Tanks

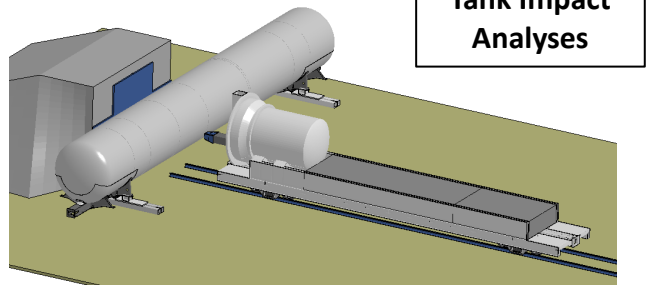
PROJECT DESCRIPTION

- Conduct high-fidelity impact and puncture modeling to assess critical railroad transport and storage equipment for liquid hydrogen (LH_2).
- The project will assess the safety of LH2 through the following tasks:
  - Analyze cryogenic material data at LH_2, LN_2, and LNG temperatures (21, 77, 110K).
  - Develop constitutive and damage models for appropriate steels at test temperatures.
  - Apply impact and puncture modeling capabilities to assess the safety of LN_2 storage systems (e.g., tank cars, tenders, and/or transport tanks) for the railroad crash and impact hazard environment.
  - Develop a test plan for LH_2 impact and puncture testing for LH_2 transport safety and rupture consequence assessment.

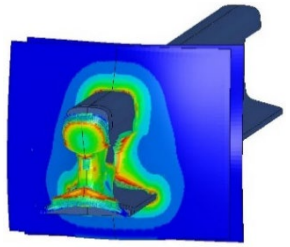
Cryogenic Material Modeling



Tank Impact Analyses



ISO T75 Tank



Puncture Analysis (Rail Impactor)

RAILROAD IMPACT

- Provides railroads and equipment builders with design requirements and potential configurations for safely introducing railroad LH_2 fuel storage systems.
- Evaluates relative puncture risk for transport of LH_2 by rail.
- Develops test data and modeling capabilities to analyze potential design alternatives.
- Identifies mitigation strategies to improve safety for various LH_2 storage systems.
- Improves safety for railroad personnel operating future LH_2 fuel locomotives.

PROJECT PARTNER

- Applied Research Associates, Inc.

COST & SCHEDULE

- FY25 Funding: $129,109
- Project Duration: August 2025 – February 2027

U.S. Department of Transportation
Federal Railroad Administration

FRA PROJECT MANAGER: Brian Won• (202) 893-6468 • brian.won@dot.gov

Fire-Resistant Coating Materials for Tank Cars Transporting Flammable Liquids

PROJECT DESCRIPTION

- The project applies a patented coating material to the protective housing of a tank car to improve its thermal protection in fires.
- Assess material retention when experiencing vibration or light impact as a tank car is in motion (i.e., material stability test) at the FRA Transportation Technology Center (TTC).
- Then conduct a torch fire testing at TTC to evaluate the thermal protection performance of the coating material for improving tank car safety.

RAILROAD IMPACT

- Novel tank car coating material aimed at enhancing tank car fire resistance.
- Enhance the safety of hazardous material transportation, particularly for flammable materials.
- The data collected during the field testing offers valuable information for railroad hazmat transportation risk management considering thermal protection.

PROJECT PARTNERS

- Redstone Technologies LLC
- ENSCO, Inc.
- Ambipar Response Training Center, Inc.
- Legacy Technologies LLC

COST & SCHEDULE

- FY24 Funding: $922,429
- Project Duration: September 2024 – September 2026

FRA PROJECT MANAGER: Brian Won• (202) 893-6468 • brian.won@dot.gov

SECTION THREE

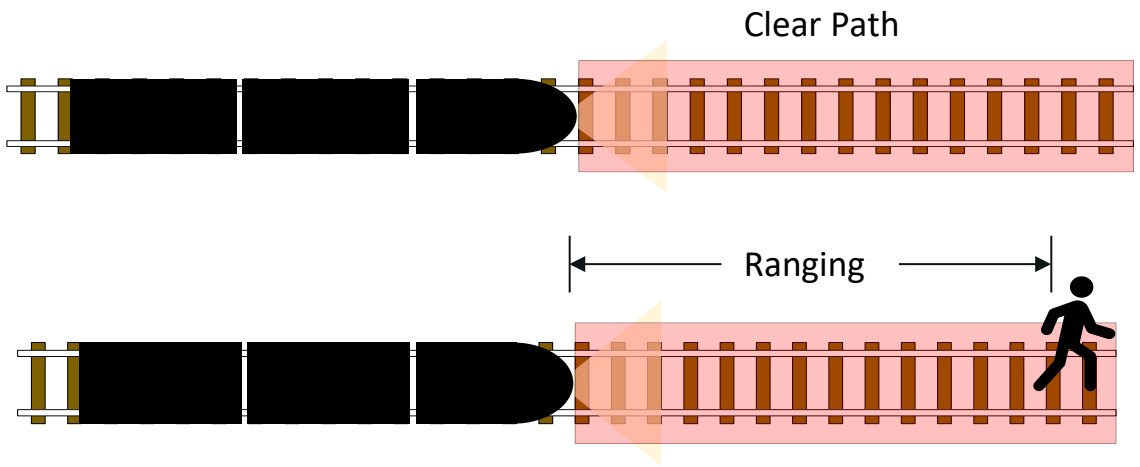
TRAIN CONTROL & COMMUNICATION

U.S. Department of Transportation
Federal Railroad Administration

Foul Volume Sensing — Clear Path and Ranging

PROJECT DESCRIPTION

- Conduct a proof-of-concept test to demonstrate if existing sensor technology can satisfy railroad-specific use cases to:
  - Detect if the path ahead of a locomotive is clear of hazards (clear path detection).
  - Detect the distance from the head of the train to the nearest potential hazard in the foul volume (ranging).



RAILROAD IMPACT

- Improves safety by increasing train crew situational awareness of potential hazards ahead of the train.
- Enables PTC enforcement of stopping short of workmen, trains, locomotives, and work equipment during restricted speed operations in work zones.
- Demonstrates foundational capabilities for a locomotive-borne sensor platform.

PROJECT PARTNERS

- MxV Rail
- ENSCO, Inc.

COST & SCHEDULE

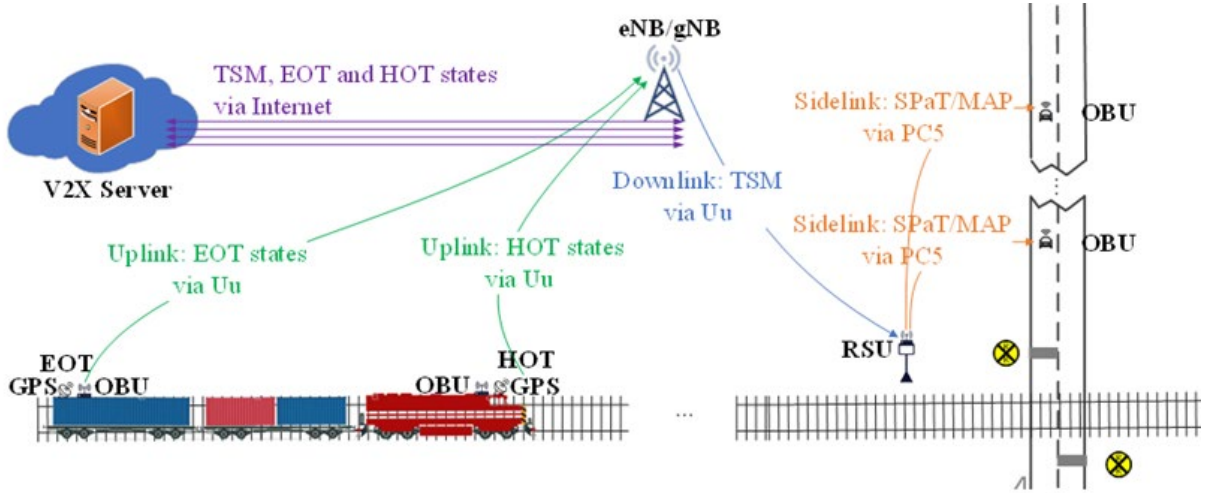
- Funding: $740,000
- Project Duration: September 2025 – March 2027

FRA PROJECT MANAGER: Jared Withers • (202) 450-0808 • jared.withers@dot.gov

C-V2X Train Arrival and Departure Information at Grade Crossings – Assessment

PROJECT DESCRIPTION

- Evaluate the performance and analyze the feasibility of C-V2X (cellular vehicle-to-everything) communication to provide real-time train status (i.e., position, speed, and heading information) and predicted train approaching and departure information to connected vehicles at grade crossings via field testing.
- Design, build, and test C-V2X 4G/5G-based rail crossing violation warning (RCVW) architecture to support passive grade crossing warning.
- Evaluate a cloud-based solution for predicted signal, phase, and timing (SPAT) for grade crossings.
- Develop train-specific messaging requirements and advocate for their inclusion in SAE/IEEE communication standards.



RAILROAD IMPACT

- Propose and analyze a solution to expand the RCVW architecture to support passive grade crossings which enhances the applicability of the architecture.
- The proposed solution and feasibility assessment will provide guidance on future research needs and/or prototypes that improve safety of connected vehicles at grade crossings.
- Improve grade crossing safety.

PROJECT PARTNERS

- ENSCO, Inc.
- Michigan Technological University

COST & SCHEDULE

- Funding: $1,690,514
- Project Duration: August 2023 – May 2026

FRA PROJECT MANAGER: Jared Withers • (202) 450-0808 • jared.withers@dot.gov

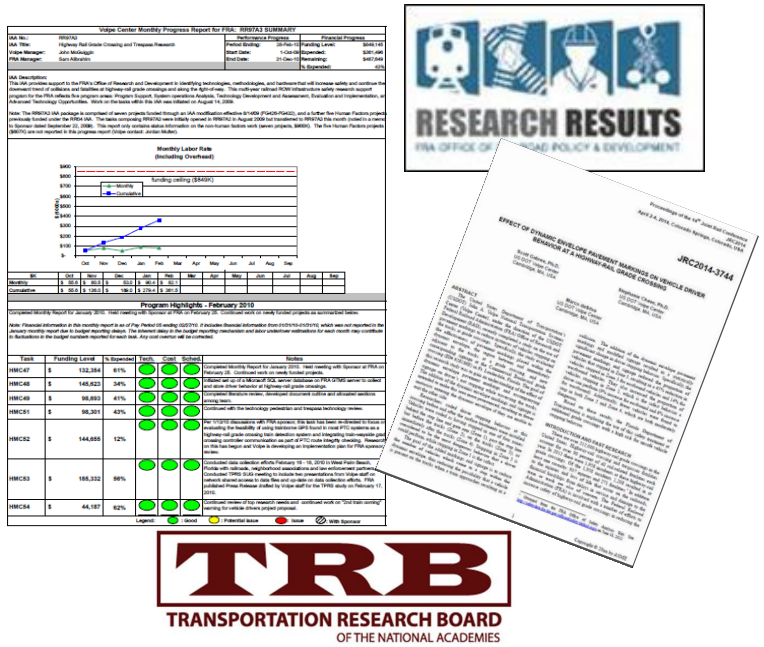
Grade Crossing and Trespass Research Program Support

PROJECT DESCRIPTION

- Provide program management, quick response, conduct special studies not covered in any existing task, and support for other requests requiring immediate attention.
- Participate in professional activities within the scope of research topic which are not specifically funded under another task (e.g., TRB AHB60 Committee, AREMA, ITE, technical papers).
- Information exchange on cutting-edge technologies and/or strategies for grade crossing safety and trespass prevention (including outreach to FRA grade crossing managers).
- Provide reports to define and track, on a periodic basis, key activities in support of the research program.

RAILROAD IMPACT

- Provides for information exchange with State DOTs and railroads on cutting-edge technologies and/or strategies for grade crossing safety and trespass prevention.
- Provides quick response capability in support of FRA RD&T.
- Provides support to FRA RD&T on studies requiring immediate action not covered in any existing task.



PROJECT PARTNER

- Volpe National Transportation Systems Center

COST & SCHEDULE

- Funding: $475,000
- Project Duration: July 2021 – July 2026

FRA PROJECT MANAGER: Francesco Bedini Jacobini • (202) 493-0800 • Francesco.Bedini@dot.gov

Grade Crossing Lights Flash Rate Research

PROJECT DESCRIPTION

- Research the effectiveness of changing the flash rate of grade crossing flashers on driver compliance with grade crossing warning devices.
- The Massachusetts Dept. of Transportation (MassDOT), in collaboration with FRA RRS, has submitted a request for experimentation to the FHWA for this technology.
- FRA RRS requested RD&T support with evaluation of the technology and effect on driver compliance at a grade crossing (Crossing ID 546729P) on the MBTA system in Canton, MA.
- Volpe researchers will collect data at the crossing before and after the installation of rapid flashing LED flashers and evaluate driver compliance.
- Research Results of gate-mounted flashers: https://rosap.ntl.bts.gov/view/dot/77623

U.S. Department of Transportation
Federal Railroad Administration

RESEARCH RESULTS

RR 24-10 | September 2024

EFFICACY OF INCREASED FLASH RATE OF RAILROAD GATE FLASHERS

SUMMARY

Under the direction of the Federal Railroad Administration's (FRA's) Train Control and Communication Research Division, the Volpe National Transportation Systems Center (Volpe) conducted a study to evaluate the effectiveness of increasing the flash rate of gate-mounted flashers on driver compliance with grade crossing warning devices.

Results from data collected and analyzed during a field-test of the technology in 2023 indicate that gate-mounted rapid flash rate light-emitting diode (LED) flashers reduced grade crossing violations by motorists. The number of violations per grade crossing activation decreased by about 22 percent after the installation of the new flashers. The average time of violation, measured as time elapsed since grade crossing activation, decreased by 18 percent (from 3.4 seconds on average before installation to 2.8 seconds on average post-installation). Results also showed a 35 percent decrease in the violation rate for nighttime grade crossing activations, indicating that the rapid flashers improved the conspicuity of the active warning devices at the grade crossing.

BACKGROUND

Motorists whose visibility is obscured or who are distracted while approaching a rail-highway at-grade crossing may not notice the standard railroad gates and flashing lights. This can lead to unsafe situations such as motorists stopping within the dynamic envelope of the crossing, breaking the descending or horizontal gate, or driving through the crossing and colliding with a train. Figure 1 shows an incident involving a driver violating the crossing gate at the study crossing on Washington Street in Canton, MA (ID# 546 729P), which resulted in a broken gate.

Figure 1. Crossing Gate Violation Example (Crossing ID# 546 729P)

Flashers at active grade crossings flash at a rate of about 1 hertz (Hz), or one flash per second, during a grade crossing activation. The idea of a higher flash rate for grade crossing flashers was developed at Railway Equipment Company (RECO) in Delano, MN. Engineers developed a flashing light activation sequence, similar to that on a police car, that aims to capture the motorist's attention in more quickly and effectively.

The proposed flashing lights aim to increase the flash rate of each light up to 5 Hz (for a strobe effect) during the initial phase of the activation. Once the roadway gate descends to a full horizontal position, the flash rate will resume back to about 1 Hz.

The Massachusetts Department of Transportation (MassDOT) received approval from the Federal Highway Administration

RAILROAD IMPACT

- Develops, implements, and evaluates techniques or technologies that reduce violations of grade crossing traffic control devices that may lead to incidents and casualties (2,197 incidents and 274 fatalities at crossings in 2022).
- Facilitates implementation and evaluation of innovative safety technologies.
- Provides FRA partners with information on cutting-edge technologies and/or strategies for grade crossing safety.
- Provides partnerships with State DOTs and railroads.

PROJECT PARTNERS

- Volpe National Transportation Systems Center
- MassDOT
- MBTA
- Keolis

COST & SCHEDULE

- Funding: $200,000
- Project Duration: February 2023 – July 2026

FRA PROJECT MANAGER: Francesco Bedini Jacobini • (202) 493-0800 • Francesco.Bedini@dot.gov

Enhanced ENS Signage Research

PROJECT DESCRIPTION

- Evaluate the effectiveness of adding a “NOTICE” sign (MUTCD W16-18P) to the existing Emergency Notification System sign at highway-rail grade crossings.
- Addition of the NOTICE sign may increase ENS sign visibility to the public. To this end, Volpe is supporting FRA in partnering with a transit agency to evaluate the impact of adding these signs on ENS sign visibility.
- The Massachusetts Dept. of Transportation (MassDOT), in collaboration with FRA RRS, have submitted a request for experimentation to the FHWA for this signage combination.
- The following research activities are anticipated: site selection, baseline data collection, installation, post data collection, and analysis/report.

RAILROAD IMPACT

- Identifies and evaluates potential location and enhancements of current ENS signs to increase visibility/conspicuity to the public.
- Potentially provides incident-preventing warning to operating railroad ahead of potential crash at a crossing due to a stalled or stuck vehicle.
- Provides supported analysis for potential legislative processes.
- Provides partnerships with State DOTs and railroads.

PROJECT PARTNERS

- Volpe National Transportation Systems Center
- MassDOT
- MBTA
- Amtrak
- Canadian National Railway

COST & SCHEDULE

- Funding: $100,000
- Project Duration: March 2023 – July 2026

FRA PROJECT MANAGER: Francesco Bedini Jacobini • (202) 493-0800 • Francesco.Bedini@dot.gov

Innovative Pedestrian Treatments

PROJECT DESCRIPTION

- Review, select, and evaluate emerging technologies and application for detecting and warning pedestrians violating grade crossing protection devices.
- Develop and field-test a pedestrian detection and warning prototype system for grade crossing applications.
- New technologies or approaches to mitigate this problem, such as pedestrian warning boxes currently operational in Belgium, will be investigated for possible demonstration at high-risk locations. Further development and evaluation of artificial intelligence tools for pedestrian trespass detection will also be investigated.
- Prototype System deployed and evaluated at a highway-rail grade crossing in the Borough of Fair Lawn, NJ (Crossing ID 263156A).

RAILROAD IMPACT

- Demonstrates and evaluates new technologies and strategies that increase pedestrian safety at grade crossings; 163 pedestrian incidents at grade crossings occurred in 2022 (about 7% of total crossing incidents).
- Provides partnerships with State DOTs and railroads.
- Facilitates implementation and evaluation of innovative safety technologies.
- Provides information exchange with rail safety partners on cutting-edge technologies and/or strategies.

PROJECT PARTNERS

- Volpe National Transportation Systems Center
- NJ DOT
- New Jersey Transit

COST & SCHEDULE

- Funding: $200,000
- Project Duration: March 2023 – December 2025

FRA PROJECT MANAGER: Francesco Bedini Jacobini • (202) 493-0800 • Francesco.Bedini@dot.gov

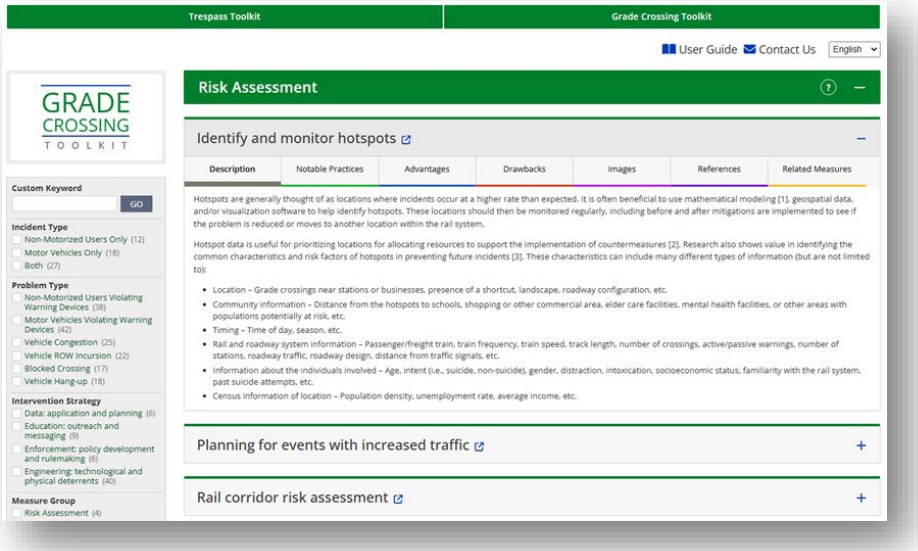
Grade Crossing Toolkit

PROJECT DESCRIPTION

- Support the development of a highway-rail grade crossing safety measures toolkit — such as the rail ROW trespass mitigation measures toolkit currently under development by FRA RD&T.
- This toolkit will contain guides, noteworthy practices, and research results on the implementation of a wide range of grade crossing safety treatments.
- Such a resource has been developed in Europe and is widely used — the SAFER-LC Toolbox (https://safer-lc.eu/). FRA has developed a toolkit for rail trespass and suicide treatments (https://trespasstoolkit.fra.dot.gov/) and has identified the need for a similar resource repository for grade crossing safety countermeasures for U.S. stakeholders.
- Grade Crossing Toolkit initial release, November 2024

RAILROAD IMPACT

- Provides FRA partners with information on cutting edge technologies and/or strategies for grade crossing safety.
- Fosters an exchange of information on grade crossing safety countermeasures between all stakeholders.
- Facilitates implementation and evaluation of innovative safety technologies.
- Facilitates development of site-specific strategies for grade crossings, thereby improving rail safety.



PROJECT PARTNER

- Volpe National Transportation Systems Center

COST & SCHEDULE

- Funding: $275,000
- Project Duration: July 2021 – December 2025

FRA PROJECT MANAGER: Francesco Bedini Jacobini • (202) 493-0800 • Francesco.Bedini@dot.gov

SSM/ASM Effectiveness in Quiet Zones

PROJECT DESCRIPTION

- Study the effectiveness of Supplementary Safety Measures (SSMs) and Alternative Safety Measures (ASMs) implemented at quiet zones. Volpe researchers will collect incident data at grade crossing before and after the installation of SSMs and ASMs to determine the effects of implementation of those measures.
- Localities seeking to establish a quiet zone are first required to mitigate the increased risk at grade crossings caused by the absence of a horn. This is typically done with SSMs such as gates with channelization or medians, four-quadrant gates, one-way streets with gates, and crossing closures.
- SSMs are engineering improvements, which, when installed at highway-rail grade crossings within a quiet zone, would reduce the risk of a collision at the crossing.

RAILROAD IMPACT

- Provides updated safety measures effectiveness ratings. Current effectiveness ratings were developed 15+ years ago and need to be updated.
- Provides supported analysis for potential legislative processes.

PROJECT PARTNER

- Volpe National Transportation Systems Center

COST & SCHEDULE

- Funding: $250,000
- Project Duration: March 2023 – December 2025

FRA PROJECT MANAGER: Francesco Bedini Jacobini • (202) 493-0800 • Francesco.Bedini@dot.gov

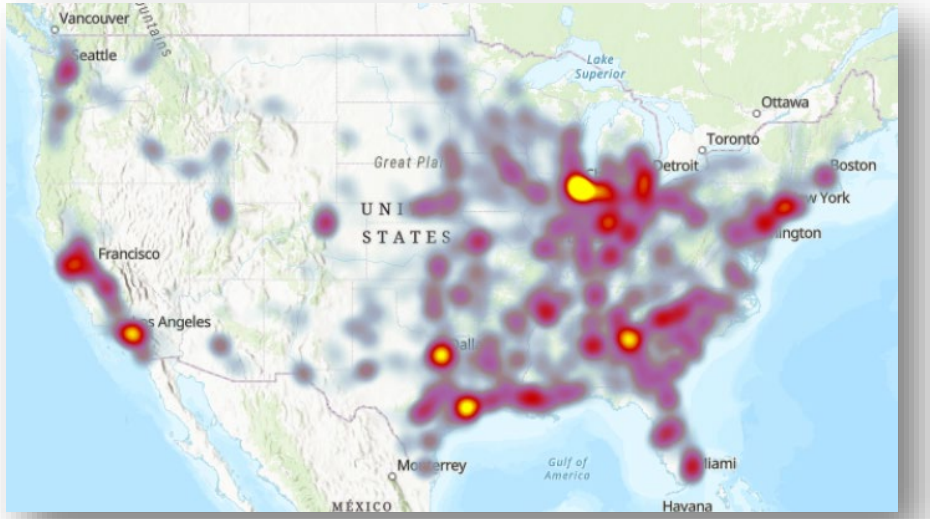
Grade Crossing Data Analyses

PROJECT DESCRIPTION

- Conduct an analysis of the most dangerous crossings in the U.S..
- Researchers will also explore the feasibility of developing tools for querying incident and inventory information from FRA data.
  - This will include researching various tool options, including excel, PowerBI, VBA.
  - Researchers will also determine if feasible to revive the adapt-x excel tool, update it, and add inventory data.
- Study will also investigate potential use of FRA's Grade Crossing Accident Prediction System (GXAPS) for this purpose.

RAILROAD IMPACT

- Provides tools for stakeholders to assess crossing risk and implement mitigation strategies.
- Fosters an exchange of information on grade crossing safety countermeasures among stakeholders.
- Facilitates the implementation and evaluation of innovative safety technologies.
- Facilitates development of site-specific strategies for grade crossings, thereby improving rail safety.
- Provides supported analysis for potential legislative processes.
- Quick response capability.



PROJECT PARTNER

- Volpe National Transportation Systems Center

COST & SCHEDULE

- Funding: $100,000
- Project Duration: June 2025 – July 2026

FRA PROJECT MANAGER: Francesco Bedini Jacobini • (202) 493-0800 • Francesco.Bedini@dot.gov

Safety Impact of FRA's Railroad Trespassing Enforcement Grant Program

PROJECT DESCRIPTION

- Collecting and reviewing the results of multiple rounds (2019-2024) of law enforcement grants through multiple avenues, including CRISI.
- The objective is to document the safety impact resulting from the activities conducted under those grants.
- The analysis will consist of analyzing the process of issuing these grants as well as studying the impact of specific activities conducted by law enforcement organizations funded by these.
- This work builds on a previous study conducted by the Volpe Center for a 2019 FRA pilot program where four local law enforcement agencies were awarded funding to enforce trespassing laws on rail ROWs. The results of that pilot demonstration project are documented in a final report: (https://rosap.ntl.bts.gov/view/dot/53546)

RAILROAD IMPACT

- Quantifies benefits of dedicated dedicating federal funds to local law enforcement agencies to perform rail trespassing enforcement activities.
- Provides supported analysis for potential legislative processes.
- Increases public safety.

PROJECT PARTNER

- Volpe National Transportation Systems Center

COST & SCHEDULE

- Funding: $75,000
- Project Duration: June 2025 – July 2026

FRA PROJECT MANAGER: Francesco Bedini Jacobini • (202) 493-0800 • Francesco.Bedini@dot.gov

CARE Model Community Focus Groups

PROJECT DESCRIPTION

- Coordinate with community leaders and other stakeholders to identify local rail trespass issues, implements countermeasures, and evaluate the impact.
- Outreach will be conducted to gather insights from the different populations identified by the core stakeholder group.
- Host focus groups to identify the specific needs of the diverse set of stakeholders in the community.
- Conduct qualitative analyses and propose mitigation strategies.
- Document findings, which will be used to inform decisions about what safety enhancements to pursue and how they should be implemented to best meet the needs of the community.
- Incorporate focus group process and outcomes into CARE Model pilot test documentation.

RAILROAD IMPACT

- Reduces trespass fatalities on U.S. rail networks.
- Demonstrates potential benefits, including documenting best practices and lessons learned, of implementation and evaluations conducted within the study areas.
- Empowers communities to proactively address rail safety issues without government assistance.
- Increases public safety.

PROJECT PARTNERS

- Volpe National Transportation Systems Center
- Community leaders

COST & SCHEDULE

- Funding: $100,000
- Project Duration: June 2025 – July 2026

FRA PROJECT MANAGER: Francesco Bedini Jacobini • (202) 493-0800 • Francesco.Bedini@dot.gov

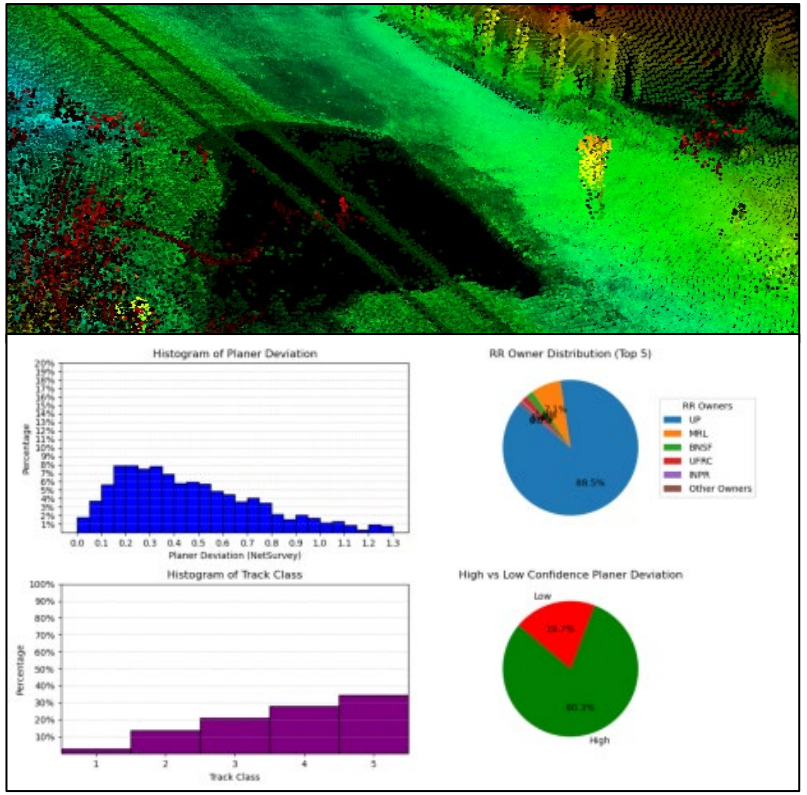
LiDAR Grade Crossing Scanning and Data Hosting Support

PROJECT DESCRIPTION

- The project supports FRA's LiDAR Grade Crossing Inspection System, which collects 3D point clouds from ATIP vehicles (DOTX 220 and DOTX 304) to identify high-profile grade crossings and other hazards.
- Continued operational support to ensure scanners, onboard processors, and data storage systems function reliably during nationwide surveys.
- The effort also assists FRA IT in establishing a cloud-hosted repository for long-term storage and retrieval of LiDAR point clouds, metadata, BEV imagery, and orthographic crossing views.
- The project includes manual and automated data transfers, develop onboard data-handling software, and validate data structures to support FRA's long-term analytical and safety objectives.

RAILROAD IMPACT

- The project enhances FRA's ability to identify high-profile grade crossings and assess hazards that may contribute to vehicle hang-ups and potential train collisions.
- Continuous support for the LiDAR systems on ATIP vehicles ensures consistent, accurate nationwide data collection.
- The development of a cloud-hosted data repository and automated data transfer pipeline will significantly reduce the time required to deliver crossing data to FRA and stakeholders. Expanded accessibility to detailed LiDAR scans, metadata, and imagery enables faster validation of safety concerns and more informed planning by railroads and DOT partners. These improvements strengthen national grade-crossing safety and support the proactive mitigation of high-risk locations



PROJECT PARTNER

- ENSCO, Inc.

COST & SCHEDULE

- Funding: $807,745
- Project Duration: October 2024 – September 2027

U.S. Department of Transportation
Federal Railroad Administration

FRA PROJECT MANAGER: Francesco Bedini Jacobini • (202) 306-8156 • Francesco.Bedini@dot.gov

SECTION FOUR

HUMAN FACTORS

Short Line Safety Institute (SLSI): Annual Grant Program Oversight

PROJECT DESCRIPTION

- FRA's Human Factors Division provides program monitoring and support for SLSI.
- Officially established as a nonprofit organization in 2016, SLSI conducts voluntary, non-punitive, confidential Safety Culture Assessments (SCAs) for short line and regional railroads across the U.S.
- SCAs provide a diagnostic appraisal of a railroad's safety culture at a given point in time, with documented Opportunities for Improvement across the USDOT Safety Council's Ten Core Elements of a Strong Safety Culture (adapted for a railroad setting).
- SLSI funding is an earmark grant provided annually by Congress.

RAILROAD IMPACT

- SLSI enhances the safety culture and safety performance of railroads through meaningful and productive partnerships.
- Impacts include:
  - Conducting SCAs and providing recommendations on how to improve safety culture.
  - Serving as a research center that compiles and disseminates information on safety needs and trends.
  - Communicating research findings to stakeholders about safety culture improvement efforts.

Short Line Safety Institute

PROJECT PARTNER

- Short Line Safety Institute

COST & SCHEDULE

- FY26 Funding: $2,425,000
- Project Duration: Ongoing

FRA PROJECT MANAGER: Starr Kidda, Ph.D • (202) 306-2011 • Starr.Kidda@dot.gov

Short Line Safety Institute (SLSI): Program Evaluation

PROJECT DESCRIPTION

- The Volpe Center conducts a program evaluation of the effectiveness and fidelity of SLSI's program and outreach activities.
  - SLSI activities include Safety Culture Assessments (SCAs) and Leadership Development Trainings.
- This evaluation:
  - Identifies strengths and opportunities for improvement in SLSI processes (e.g., developing SCA reports).
  - Provides tools (e.g., fidelity assessment tool) for SLSI to assess its internal processes.
  - Helps ensure effective and consistent delivery of SLSI services to short line and regional railroads.

RAILROAD IMPACT

- SLSI provides free training and SCAs to interested railroads. The evaluation of SLSI's safety outreach activities provides SLSI with opportunities to improve the effectiveness and fidelity of their processes, tools, and SCA and training delivery.
- Objective, third-party, evaluative feedback allows SLSI to grow and improve its offerings to the industry, which is intended to strengthen safety culture and improve safety outcomes.

PROJECT PARTNERS

- Volpe National Transportation Systems Center
- Short Line Safety Institute

COST & SCHEDULE

- FY25 Funding: $177,000
- FY26 Funding: $150,000
- Project Duration: Ongoing

FRA PROJECT MANAGER: Starr Kidda, Ph.D. • (202) 306-2011 • Starr.Kidda@dot.gov

Railroad Information Sharing Partnerships: RISE, SOFA and FAMES

PROJECT DESCRIPTION

- Support development of the Railroad Information Sharing Environment (RISE), a voluntary, non-regulatory, data-driven safety partnership between FRA and the railroad industry. RISE stakeholders share data to solve complex railroad safety issues.
  - Assist with the development of internal and external documentation to help clarify the value of voluntary safety data sharing through the RISE program.
  - Coordinate with railroad stakeholders to identify potential topics which may benefit from data analysis.
- Support voluntary working groups such as Switching Operations Fatality Analysis (SOFA) and Fatality Analysis of Maintenance of Way and Signalmen (FAMES).
  - Facilitate SOFA and FAMES Committees' communication, outreach, and database maintenance and analysis.

RAILROAD IMPACT

- Voluntary working groups like SOFA and FAMES, and programs like RISE provide a mechanism for railroads and rail stakeholders to confidentially and anonymously share safety information for analysis.
  - Aggregated safety data may provide a way for the railroad industry to identify safety risk indicators present in the system before they result in more significant issues.
- SOFA and FAMES Committees' findings and recommendations provide educational and operational information intended to help reduce the risk of on-duty fatalities.

RISE
Railroad Information Sharing Environment

Fatality Analysis of Maintenance-of-way Employees and Signalmen
FAMES

PROJECT PARTNERS

- Volpe National Transportation Systems Center
- UMD Center for Advanced Transportation Technology (CATT) Lab
- MITRE

COST & SCHEDULE

- FY26 Funding: $1,345,000
- Project Duration: Ongoing

FRA PROJECT MANAGER: Shala Blue, Ph.D. • (202) 493-0168 • Shala.Blue@dot.gov

Railroad Worker and Operator Performance

PROJECT DESCRIPTION

- Document the ways in which critical incidents (per 49 CFR § 272.9) and close calls experienced by railroaders are related to safety, fatigue, trauma, and well-being.
- Work with FRA's Office of Railroad Safety, labor, and industry stakeholders to better understand human factors issues around safety, safety programs, safety culture, and industry regulations.
  - Review and communicate research needs, provide subject matter expertise, and facilitate discussions with other researchers and DOT operating administrations.
  - Develop research studies on total worker health, work performance, and factors contributing to railroad worker fatigue.

RAILROAD IMPACT

- Help railroads improve CISPs and associated programs, processes, and trainings through sharing good practices and lessons learned.
- Help improve the safety, health and well-being of railroad workers.
- Evaluate safety programs to mitigate the risk of accidents and reduce injuries and fatalities.
- Encourage reporting of safety hazards and concerns.
- Facilitate a safer workplace environment which can boost employee morale, reduce turnover, maintain consistent service, reduce costs, and increase employee productivity and engagement.

PROJECT PARTNERS

- Volpe National Transportation Systems Center
- FRA Office of Railroad Safety
- Partner railroads

COST & SCHEDULE

- FY25 Funding: $250,000
- FY26 Funding: $550,000
- Project Duration: Ongoing

FRA PROJECT MANAGER: Shala Blue, Ph.D. • (202) 493-0168 • Shala.Blue@dot.gov

Rail Industry Recruitment Toolkit

PROJECT DESCRIPTION

- Support improved recruitment outcomes for the rail industry by:
  - Documenting accelerators and inhibitors to increasing recruitment, especially lessons learned in similar industries.
  - Identifying key points of connection in middle school, high school, and post-secondary curricular focus and career pathway planning structures via case study analysis.
  - Determine resource needs for enhancing outreach and recruitment efforts.
  - Developing Rail Industry Recruitment Toolkit.

RAILROAD IMPACT

- Position rail as an industry of choice through resources available in the Rail Industry Recruitment Toolkit.
- Toolkit will include:
  - Impactful Practice Case Studies
  - GIS database of potential recruitment partners
  - Rail Industry Spotlights
  - Rail Career Quick Facts
  - Rail Industry Recruitment Playbook
- Toolkit materials will be disseminated broadly to maximize awareness and use.

PROJECT PARTNERS

- University of Memphis Southeast Transportation Workforce Center (SETWC), Fairpointe Planning, LLC., Tuskegee University
- Rail industry advisory committee – including Class I, regional, short line, and passenger rail representatives

COST & SCHEDULE

- FY26 Funding: $350,000
- Project Duration: 2 years

FRA PROJECT MANAGER: Shala Blue, Ph.D. • (202) 493-0168 • Shala.Blue@dot.gov

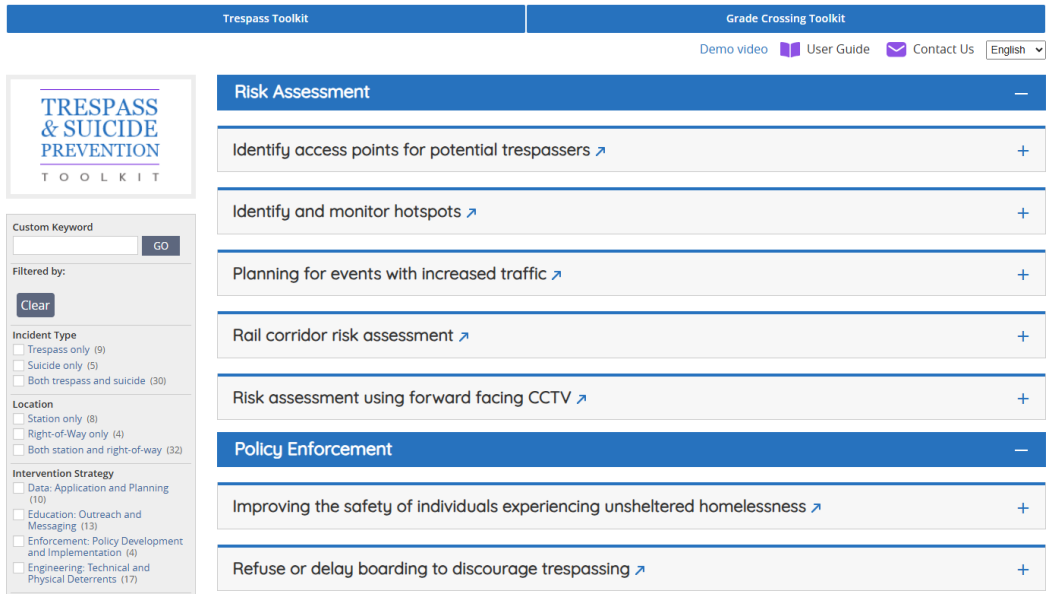
Highway-Railroad Grade Crossing, Railroad Trespass and Suicide Prevention: Toolkit and Web Resources

PROJECT DESCRIPTION

- Support the updating, maintenance, and improvement of existing FRA resources, including the Trespass & Suicide Prevention Toolkit (TSP Toolkit).
- Coordinate with stakeholders and researchers to identify new findings to incorporate into the TSP Toolkit.
- Refine existing and develop new web-based resources that empower railroad and community stakeholders to improve safety without the need for direct federal contact.

RAILROAD IMPACT

- Easy-to-use resource for railroad stakeholders to identify how to address their own risks.
- Sharable resource that allows railroads to direct potential collaborators, such as towns or local organizations, to learn more about how they can partner with the railroad to help improve safety.
- Up-to-date information with links to resources that help empower action at the local level.



PROJECT PARTNER

- Volpe National Transportation Systems Center

COST & SCHEDULE

- FY25 Funding: $75,000
- FY26 Funding: $75,000
- Project Duration: Ongoing

FRA PROJECT MANAGER: Shala Blue, Ph.D. • (202) 493-0168 • Shala.Blue@dot.gov

GX, Railroad Trespass, and Suicide Prevention: Working Group Facilitation & Support

PROJECT DESCRIPTION

- Support U.S.-based and international working groups related to highway-rail grade crossing safety and trespassing and suicide prevention, including:
  - Global Railway Alliance for Suicide Prevention (GRASP)
  - Suicide Prevention for US Rail (SPUR)
  - Trespass and Suicide Prevention (TreSP) Network
  - Federal Working Group for Suicide Prevention (FWG)
  - National Action Alliance for Suicide Prevention
  - Operation Lifesaver, Inc. (OLI)
- Prepare, host, and document all GRASP and SPUR meetings.
- Document key takeaways from meetings hosted by others and bring back findings to FRA and industry.

RAILROAD IMPACT

- Forum to gather good practices and insights from international experts and bring them back for US implementation.
- Space to meet quarterly with railroads and discuss rail safety issues and emerging mitigation strategies.
- Collaboration with unique set of partners to share expertise and resources (time and/or funding) to help address issues of shared concern.

GRASP

Global Railway Alliance for Suicide Prevention

SPUR

Suicide Prevention for US Rail

PROJECT PARTNERS

- Volpe National Transportation Systems Center
- Operation Lifesaver, Federal Working Group for Suicide Prevention, DuPage Rail Safety Council, Dept. of Veterans Affairs, International Union of Railways

COST & SCHEDULE

- FY25 Funding: $100,000
- FY26 Funding: $100,000
- Project Duration: Ongoing

FRA PROJECT MANAGER: Shala Blue, Ph.D. • (202) 493-0168 • Shala.Blue@dot.gov

Highway-Railroad Grade Crossing, Trespass and Suicide Prevention: Community-Based Interventions

PROJECT DESCRIPTION

- Directly coordinate with community stakeholders and railroads to refine and document a process that empowers communities to directly address railroad safety risks.
- Build upon the CARE (Community, Analysis, Response, Evaluation) Model to incorporate additional stakeholders and data sources, including behavioral and public health resources.
- Conduct case studies with motivated communities and document good practices and lessons learned.
- Identify a way for this process to be distilled and communicated publicly so that other communities can adopt similar approaches to safety improvement.

RAILROAD IMPACT

- Documented strategy to share responsibility for railroad safety improvements with other community stakeholders
- Defined process to help identify rail safety issues most relevant to specific communities
- Defined path to identify potential partners to share in funding mitigation strategies or providing resources subject matter expertise.
- Opportunity to implement and evaluate mitigations strategies and document evidence of effectiveness.

PROJECT PARTNERS

- Volpe National Transportation Systems Center
- City of Lake Worth Beach, FL; Brightline; Palm Beach Sheriff's Office; 211 Florida; City of Abington, MA; MBTA; Keolis

COST & SCHEDULE

- FY25 Funding: $160,000
- FY26 Funding: $300,000
- Project Duration: Ongoing

FRA PROJECT MANAGER: Shala Blue, Ph.D. • (202) 493-0168 • Shala.Blue@dot.gov

Simulator Research Support

PROJECT DESCRIPTION

- Support FRA's locomotive cab simulator and FRA's railroad crossing driving simulator (i.e., activities related to hardware, software, lab facilities).
- Facilitate the conduct of FRA's simulation research projects (e.g., designing and programing scenarios, data collection, technical advising).
- Research program and strategic planning support.

RAILROAD IMPACT

- Provides platform and capability to study the boundaries of operator capability and performance, as well as the impact new technologies may have on them.
- Ability to study human performance in ways not possible outside the lab.
- Reduction in operator errors caused by human factors issues.

PROJECT PARTNER

- Volpe National Transportation Systems Center

COST & SCHEDULE

- FY25 Funding: $80,000
- FY26 Funding: $80,000
- Project Duration: Ongoing

FRA PROJECT MANAGER: Donald Tweedie • (571) 548-2324 • Donald.Tweedie@dot.gov

Research Supporting Safety in Railroad Technology, Automation, and Systems Design

PROJECT DESCRIPTION

- Research addressing issues such as:
  - Current and future uses of technology
  - Impact of technology on the roles and work tasks of humans
  - How humans and automated technology may most effectively work together toward goals
  - Challenges related to the design and use of automation and other technology
- Help communicate technology-related information to stakeholders.
- Upcoming research projects:
  - Human Factors Evaluation of Remote Monitoring Tools for Track and Equipment Safety
  - Assessing Dispatch Operator Decision-making Under System Failures
  - Automated Track Change Detection User Needs Assessment Publication

RAILROAD IMPACT

- Increase safety by considering the needs, capabilities, and limitations of the humans that will interact with, or be otherwise impacted by, new technology.

PROJECT PARTNER

- Volpe National Transportation Systems Center

COST & SCHEDULE

- FY26 Funding: $250,000
- Project Duration: ongoing

FRA PROJECT MANAGER: Donald Tweedie • (571) 548-2324 • Donald.Tweedie@dot.gov

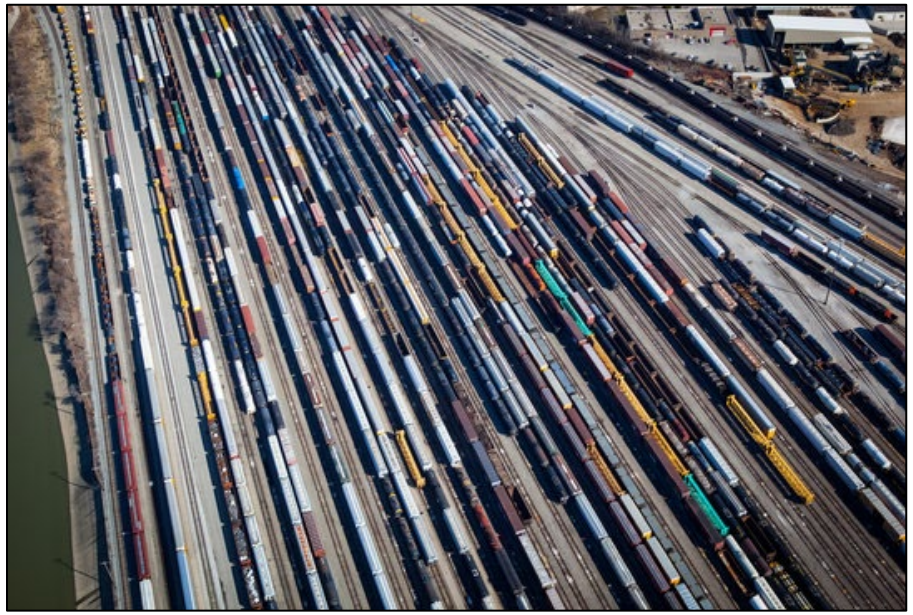
Railroad Worker Safety During Remote Switching and Shoving Movements

PROJECT DESCRIPTION

- This project originates from the Transportation Safety Board Railroad Safety Research group's Research Needs Statement, which advocates for railroad worker safety research on switching and shoving yard movements.
- Focuses on assessing safety and operational performance of remote-controlled locomotives (RCLs) used to conduct movements from a distance.
- Evaluates how RCLs impact worker safety, situation awareness, workload, communication, and risk exposure in real operating environments.
- Develops evidence-based practices and requirements to guide safe and effective use of RCLs in yard operations.

RAILROAD IMPACT

- Provides best practices for implementation and strengthens safety standards and compliance with research-backed operating procedures tailored to real yard environments.
- Improves operational efficiency through more precise, consistent RCL operations.
- Enhances worker safety by reducing direct exposure to hazards during switching and shoving movements.



PROJECT PARTNERS

- ENSCO, Inc.
- Labor unions
- Industry partners
- Further partners TBD

COST & SCHEDULE

- Planned Funding: $950,000
- Planned Duration: 1.5 years

FRA PROJECT MANAGER: Donald Tweedie • (571) 548-2324 • Donald.Tweedie@dot.gov

Error Recognition in Railyard Switching and Shoving Movements

PROJECT DESCRIPTION

- Project aims to develop a framework for how operators recognize and correct train configuration errors using real, intentionally misconfigured equipment at the FRA Transportation Technology Center (TTC).
- Provides hands-on training to railroad instructors and safety partners, giving them direct experience identifying issues such as brake misalignment and incomplete shoves.
- Collects high-resolution photos and video misconfigured conditions to support standardized, industrywide training materials.
- Included in this study would be the purchase and installation of required technologies and permanent reusable assets.

RAILROAD IMPACT

- Improves operator and instructor proficiency by giving rail industry unique opportunity to see real-world configuration errors.
- Enhances safety and reduces human-factor incidents by increasing error recognition and training rapid response.
- Supports consistent training standards across industry through TTC-validated visual materials.
- Strengthens workforce readiness by equipping instructors with practical, scenario-based media and experience.

PROJECT PARTNERS

- ENSCO, Inc.
- Labor unions
- Industry
- Further stakeholders TBD

COST & SCHEDULE

- Planned Funding: $650,000
- Planned Duration: 1 year

FRA PROJECT MANAGER: Donald Tweedie • (571) 548-2324 • Donald.Tweedie@dot.gov

Impact of Scheduling on Fatigue

PROJECT DESCRIPTION

- The Bipartisan Infrastructure Law, SEC. 22408, COMPLETION OF HOURS OF SERVICE AND FATIGUE STUDIES, requires FRA to conduct pilot studies concerning employee scheduling practices.
- A pilot project at a railroad or railroad facility to evaluate the efficacy of communicating notice of assigned shift time 10 hours prior to the beginning of their assigned shift as a method for reducing employee fatigue.
- A pilot project at a railroad or railroad facility to evaluate the efficacy of requiring railroads to improve fatigue through scheduling.

RAILROAD IMPACT

- The potential impacts will be improved safety through lowered fatigue during shifts.
- Early notification can improve sleep opportunity and preparation, reducing fatigue-related human errors, signal violations, and accidents.
- Reduced fatigue leads to fewer errors and delays, improving on-time performance and operational reliability.

PROJECT PARTNERS

- TBD, but will include labor and industry partners

COST & SCHEDULE

- Planned Funding: $350,000
- Planned Duration: 1 year

FRA PROJECT MANAGER: Donald Tweedie • (571) 548-2324 • Donald.Tweedie@dot.gov

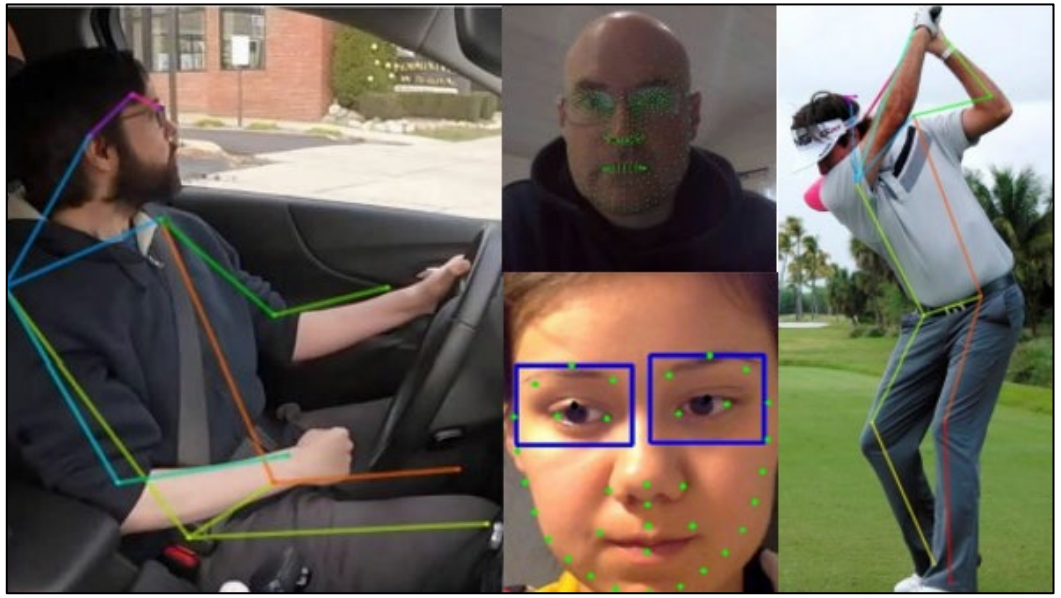
Fatigue Assessment for Transportation Engineer Determination (FATED)

PROJECT DESCRIPTION

- The Small Business Innovation Research program aims to help small business innovate and build useful technology for practical rail applications.
- This project develops a system to measure fatigue levels of operators through facial landmarks and body posture through lightweight computer vision models.
- In addition, the system will be able to implement higher-level sets of features such as yawns, slouching, micro expressions, and eye glance deviation to create a holistic fatigue profile.

RAILROAD IMPACT

- The potential integration of this system in long-distance and high-workload scenarios can aid in measuring fatigue, predicting error and accidents, and help inform fatigue management plans, scheduling, and fatigue interventions.



PROJECT PARTNERS

- Mosaic ATM, Inc.
- Labor unions
- Rail industry partners

COST & SCHEDULE

- Funding: $200,000 per phase; currently in Phase 1 of 2
- Planned Duration: 1 year per phase

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Web-Based Human Presence Detection on Railroad Corridors

PROJECT DESCRIPTION

- Follow-up to previous research to further develop proof-of-concept system that identifies areas with possible trespasser activity. System analyzes geolocation information from smart devices in designated rail corridors.
- Current effort aims to develop and implement methods to accurately predict trespassing hotspots along rail rights-of-way using mobile device data.

RAILROAD IMPACT

- Software suite can be used to identify trespassing hot spots and tailor outreach and community engagement methodologies to address those hot spots.
- Enhance safety by reducing instances of trespassing along rail corridors with higher trespassing occurrences.

PROJECT PARTNERS

- ENSCO, Inc.
- Mobile device data industry

COST & SCHEDULE

- FY24 Funding: $278,961
- FY25 Funding: $169,241
- Project Duration: July 2024 – July 2026

U.S. Department of Transportation
Federal Railroad Administration

FRA PROJECT MANAGER: Donald Tweedie • (571) 548-2324 • Donald.Tweedie@dot.gov